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# MECHANICAL PROPERTIES, INCLUDING FRACTURE TOUGHNESS AND FATIGUE, CORROSION CHARACTERISTICS AND FATIGUE-CRACK PROPAGATION RATES OF STRESS-RELIEVED ALUMINUM ALLOY HAND FORGINGS

D. J. Brownhill, C. F. Babilon
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Aluminum Company of America

TECHNICAL REPORT AFML-TR-70-10

FEBRUARY 1970

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Air Force Materials Laboratory
Air Force Systems Command
Wright-Patterson Air Force Base, Ohio



195

# MECHANICAL PROPERTIES, INCLUDING FRACTURE TOUGHNESS AND FATIGUE, CORROSION CHARACTERISTICS AND FATIGUE-CRACK PROPAGATION RATES OF STRESS-RELIEVED ALUMINUM ALLOY HAND FORGINGS

D. J. Brownhill, C. F. Babilon
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# FOREWORD

This investigation was conducted by the Alcoa Research Laboratories, Aluminum Company of America, New Kensington, Pennsylvania, under USAF Contract No. F33615-68-C-1385, Project No. 7381, "Materials Applications", Task No. 738106, "Engineering and Design Data". The work was under the direction of the Materials Laboratory, Wright-Patterson Air Force Base, Ohio, with Mr. A. W. Gunderson (MAAE) as project engineer.

This report covers work done from March 1968 through December 1969.

The investigation was made under the supervision of Mr. D. J. Brownhill with Mr. C. F. Babilon as project leader for the phase covering the mechanical properties including fracture toughness and fatigue. Mr. D. O. Sprowls was the project leader for the phase covering the corrosion characteristics and Mr. G. E. Nordmark was project leader for the phase covering the fatigue-crack propagation rates. The statistical analyses were made by Messrs. S. F. Collis and M. C. Milligan. Significant advisory and technical assistance were supplied by Messrs. J. G. Kaufman and J. D. Walsh.

The report was released by the authors for publication in January.

This technical report has been reviewed and is approved.

Albert Olevitch

ALBERT OLEVITCH
Chief, Materials Engineering Branch
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## ABSTRACT

The tensile, compressive, shear, bearing, fracture-toughness, axial-stress fatigue, resistance to stress-corrosion cracking and fatigue-crack propagation rates have been determined for a total of 40 lots of 2014-T652, 2024-T852, 7075-T7352 and 7079-T652 stress-relieved aluminum alloy hand forgings ranging in thickness from 2 through 6 in.

Tables of computed design mechanical properties and typical and minimum stress-strain and compressive tangent-modulus curves were prepared.

Average values of plane-strain stress-intensity factor, $K_{Ic}$, at 5 per cent secant offset were determined.

Log-mean fatigue-life values were calculated.

The forgings of all four alloys have a high resistance to exfoliation and a high resistance to stress-corrosion cracking when stressed in the longitudinal direction relative to the grain flow pattern. In the long and short-transverse test directions, the resistance to SCC varied markedly with respect to alloy and temper, with 7075-T7352 being outstanding, 2024-T852 rating second, and 2014-T652 or 7079-T652 rating third.

The rate of fatigue crack propagation was found to vary with the seven orientations tested and to be substantially faster in a humid atmosphere than in a dry atmosphere. For tests in a salt fog atmosphere it was demonstrated that a slower rate of loading caused a faster rate of propagation per cycle. At the lower stress intensities the alloys rate in the following decreasing order of resistance to crack propagation: 2014-T652, 2024-T852, 7075-T7352 and 7079-T652.



Key Words: 2014, 2024, 7075, 7079, aluminum, hand forgings, tensile, compressive, shear, bearing, fracture-toughness, fatigue, stress-corrosion, exfoliation, crack propagation, stress-relieved.

## TABLE OF CONTENTS

## LIST OF ILLUSTRATIONS

LIST OF ILLUSTRATIONS
(Continued)

LIST OF ILLUSTRATIONS
(Continued)

## LIST OF ILLUSTRATIONS
(Continued)

LIST OF ILLUSTRATIONS
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LIST OF ILLUSTRATIONS
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## LIST OF TABLES

LIST OF TABLES
(Continued)

LIST OF TABLES
(Continued)

LIST OF TABLES
(Concluded)

## SECTION I

## INTRODUCTION

The design mechanical properties, fracture toughness, corrosion characteristics and fatigue-crack propagation rates are four of the most important factors involved in the selection of materials and efficient design of aerospace structures. The importance of these characteristics has been emphasized by the extensive investigations made in recent years to obtain such information for aluminum alloy plate and extrusions (1-4). It is particularly timely that similar data be developed for aluminum alloy hand forgings since (a) much of the published design data has become obsolete by a change in the basis of specifying minimum tensile properties, from one in which the length, width, thickness and cross-sectional area were considered, to one where only the thickness and cross-sectional area are involved; (b) the development of a technique of stress-relieval by cold work in compression has resulted in new tempers (TX52) for many of the alloys; and (c) there have been some significant problems related to the fracture and stress-corrosion characteristics of forged parts.

Accordingly, the properties of some 2 through 6-in. thick stress-relieved 2014-T652, 2024-T852, 7075-T7352 and 7079-T652 aluminum alloy hand forgings have been determined in this investigation. The data were obtained to establish design mechanical properties for use in MIL-HDBK-5A(5), including typical and minimum stress-strain and compressive tangent-modulus curves. In addition, data concerning the fracture toughness, axial-stress fatigue, stress-corrosion, exfoliation and fatigue-crack propagation characteristics of a selected number of the hand forgings have been obtained.

## SECTION II

## MATERIAL

A total of forty 2014-T652, 2024-T852, 7075-T7352 and 7079-T652 hand forgings were produced by the Cleveland Works of Alcoa for this investigation. Each of the forgings was fabricated independently to represent an individual lot of material.

The identity, size and chemical composition of the individual hand forgings together with the respective specified composition limits are shown in Table I.

These forgings represent the range of sizes usually encountered in commercial production with regard to thickness and width/thickness ratio. The thicknesses ranged from 2 through 6 in., the widths from 5 through 24 in., and the width/thickness ratios from 1 through 4.

The chemical compositions of the forgings are within the applicable limits specified in Federal Specification QQ-A-367g, Military Specification MIL-A-22771C and "Aluminum Standards and Data", The Aluminum Association(6).

The samples were solution heat treated, cold worked and artificially aged in accordance with Military Specification MIL-H-6088D and the recommendations given in "Aluminum Standards and Data"(6). The 7075-T7352 samples were stress-relieved and aged to meet the requirements of paragraph 4.10 of Federal Specification QQ-A-367g and Paragraph 4.6.5.1 of Military Specification MIL-A-22771C.

## SECTION III

## PROCEDURE

### A. Mechanical Properties

#### A.1. Tensile, Compressive, Shear and Bearing

The specimens and test procedures were, in general, in accordance with ASTM methods, and the same as those used in previous investigations of plate and extrusions(1-4). These methods are essentially in agreement with Federal Test Method 151(7).

The tests were conducted with the smallest suitable load ranges of an Amsler 20,000-lb (Type 10SZBDA58), an Olsen Electomatic 30,000-lb, or a Southwark-Tate-Emery 50,000-lb capacity Universal Testing Machine. The machines were calibrated prior to and during the investigation; the accuracy of each was within that required by ASTM(8) and Federal Specifications.

Single specimens were tested except in a few instances where a review of the data indicated that check tests were needed.

All specimens were taken so that the test sections were within the center third of the cross-section of the forging as illustrated in Fig. 1. Tensile, compressive and shear tests were made of specimens taken in the longitudinal, long-transverse and short-transverse directions; bearing tests were made of longitudinal and long-transverse edgewise specimens.

The nominal dimensions of the specimens are shown in Figs. 2, 3 and 4.

Tensile tests were made in accordance with ASTM Methods E8(9) with 1/2-in. diameter tapered-seat specimens except where it was necessary (in the short-transverse direction) to use subsize round specimens (Fig. 2).

The compressive tests were made in accordance with ASTM Methods E9(10) using a subpress (Fig. 3 of ASTM Methods E9). The specimens were cylindrical, 1/2 in. in diameter x 1-7/8 in. long, with a slenderness ratio ($\ell/r$) of 15 (Fig. 2).

Tensile and compressive yield stresses were determined from autographic load-strain diagrams at 0.2 per cent offset.

Tests to determine the ultimate shear stress were made using 3/8-in. diameter specimens (Fig. 2) taken from the same locations as the tensile specimens, except that tests of short-transverse specimens were made only on forgings 3 in. or more in thickness. All tests were made with a relatively rigid double-shear tool, wherein a 1-in. length is sheared from a 3-in. long specimen, the end thirds being supported throughout their lengths. In the tests of longitudinal and long-transverse specimens, the loads were applied in the direction normal to the major surface of the forging; in the tests of short-transverse specimens, the loads were applied in the direction parallel to the major axis of the forging(11).

The bearing tests were made in accordance with ASTM Method E238(12), using longitudinal and long-transverse edgewise specimens, 0.094 in. thick x 1-1/2 in. wide, with a 0.375-in. diameter hole (Fig. 3). The specimens and test fixtures were cleaned ultrasonically in a suitable nontoxic solvent prior to testing. The bearing ultimate stresses and yield stresses were determined at edge distances of 1.5 and 2.0 times the pin diameter. The bearing yield stress was determined as the stress at a permanent deformation of 2 per cent of the pin diameter as indicated on autographic load-deformation diagrams.

Tensile and compressive stress-strain tests, including modulus determinations, were made of longitudinal, long-transverse and short-transverse specimens taken from a selected number of the samples. The tests were conducted in accordance with ASTM Method E111(13) with uniform-reduced-section specimens (Fig. 4). In all tests, the strains were measured over a 2-in. gage length with two Tuckerman optical strain gages positioned diametrically opposite on the specimen. A calibration made of the instruments prior to the start of these tests indicated that they meet the ASTM requirements of a Class A extensometer (14). The values of moduli of elasticity were determined by the strain-deviation method described in ASTM Method E111(13). Based on these selected tests, representative typical and minimum tensile and compressive stress-strain curves and compressive tangent-modulus curves were developed using the procedures outlined in Sections 3.2.3, 3.2.5 and 3.2.6 of Technical Report AFML-TR-66-386(15).

## A.2. Fracture Toughness

Fracture toughness tests were made of a selected number of the samples using fatigue-cracked notch-bend specimens of the types shown in Fig. 5; in each case, the largest possible size of specimen was used. The dimensions of the specimens and

the test procedures were essentially in accordance with the ASTM Proposed Method of Test For Plane-Strain Fracture Toughness of Metallic Materials(16).

Tests were made of triplicate longitudinal (LW), long-transverse (WL) and short-transverse (TL) specimens from each of the selected samples.* In the tests of the 6x24-in. 7075-T7352 forging (Sample No. 341036) in the TL direction, the largest notch-bend specimen that could be obtained from the sample was not of sufficient thickness to develop a valid test; therefore, compact tension fracture-toughness specimens of the type shown in Fig. 6 were also used. These tests were made in accordance with the ASTM Method for Plane Strain Fracture Toughness Testing of Metallic Materials(16).

The notch-bend specimens (Fig. 5) were fatigue-cracked by cantilever bending ($R=-1.0$) in a Sonntag SF-4 machine at 3650 cpm; the setup is shown in Fig. 7. The compact tension specimens (Fig. 6) were fatigue-cracked by axial loading ($R=+0.1$) in Krouse fatigue machines at 1750 cpm.

The setups used for making the fracture-toughness tests of the notch-bend and compact tension specimens are shown in Figs. 8 and 9, respectively. The tests were made in a 30 000-lb capacity Olsen screw-driven testing machine, and load versus crack opening-displacement (COD) curves were obtained autographically with a Mosley X-Y plotter. For each test, a candidate value of the critical plane-strain stress intensity factor, $K_Q$, was calculated using the load at which there was a crack extension of about 2 per cent of the original crack length, as indicated on the autographic load-displacement curve. This load was determined by applying the appropriate secant offset of 5 per cent for both the notch-bend and compact tension tests† to the autographic curves.

The $K_Q$ values were considered to be meaningful values of $K_{Ic}$, if they met the following criteria:

a. The thickness and crack length of the specimen were large with respect to the size of the plastic zone at the

---

* A two-letter system is used to describe the orientation of the fracture-toughness specimens: the first letter indicates the direction of a line normal to the crack plane and the second letter indicates the direction of crack growth. L - Length of forging; W - Width of forging; T - Thickness of forging.

† Recent action of ASTM Committee E24 has made the secant offset for compact tension specimens 5 per cent instead of 4 per cent as shown in Ref. 16.

crack tip. This requirement was considered to have been met if the thickness and crack length of the test specimen were equal to or greater than 2.5 times the ratio $(K_Q/\sigma_{YS})^2$.

b. Most of the deviation from linearity in the load-displacement curve prior to the secant-offset intersection was caused by crack extension, rather than plastic deformation of the specimen. This requirement was considered to have been met if the horizontal displacement of the load-displacement curve from the initial slope at the load equal to 80 per cent of the load at the secant offset intercept was not more than 1/4 of the displacement at the secant offset intercept.

c. The fatigue-crack front was sufficiently extended from the machined notch, and was not excessively curved or out of plane.

d. The specimen was fatigue cracked at a stress intensity which was less than half of the calculated $K_Q$ value, or $0.0012\sqrt{in.}$ times Young's modulus for the material, whichever was smaller.*

In some instances, $K_Q$ values were interpreted to be meaningful values of $K_{Ic}$ if the criteria a, c and d* were exceeded by only a slight margin, as noted in Table XXII.

### A.3. Axial-Stress Fatigue

Axial-stress fatigue tests were made on smooth specimens of the type shown in Fig. 10. Three long-transverse specimens were tested from each of several selected samples. They were tested at three stress levels (R=0.0) in Krouse fatigue machines operating at 1725 cpm.

## B. Corrosion Characteristics

A complete outline of the corrosion tests is given in Table XXV.

### B.1. Stress-Corrosion Cracking (SCC)

Five hand forgings of each alloy and temper were stress-

* Recent action of ASTM Committee E24 has moved the limit on stress intensity for fatigue cracking to 60 per cent of $K_{Ic}$, although this is not yet published in ASTM Standards.

corrosion tested. All were tested in the short-transverse direction, and the 2, 4 and 6-in. thick forgings were also tested in the longitudinal and long-transverse directions relative to the grain flow. Tensile specimens, 0.437 in. in diameter (Fig. 23), were employed for the longitudinal and long-transverse test directions, and tensile specimens, 0.125 in. in diameter (Figs. 24 and 25), were used to test the short-transverse direction. The test specimens were confined to a 2-in. thick x 6-3/8-in. wide block centered on the midplane (T/2) and on the center-line (W/2) of the forging. Inspection of macroetched slices (Figs. 25-29) indicated that this location would provide specimens with the desired orientation relative to the grain flow pattern.

The tensile specimens were stressed in "constant strain" type fixtures (Figs. 23 and 30) by means of loading devices of the type shown in Fig. 31. During exposure, the ends of the specimen and the stressing frames were protected by means of an appropriate coating so that only the test section of the specimen was exposed.

Stressed and unstressed specimens were exposed to the 3.5% NaCl alternate-immersion test. The sodium chloride solution was made with salt of 99.7-per cent purity and New Kensington tap water. Tap water was used because large volumes of water were required and because New Kensington tap water is essentially free of heavy metals. Water lost by evaporation was replaced by additions of tap water, and the salt concentration was regularly checked and adjusted as necessary. The solution was changed monthly and at each change the specimens were cleaned by spraying with tap water.

The alternate-immersion cycle consisted of total immersion of specimens for 10 minutes and aeration above the solution for 50 minutes. This cycle was continued 24 hours a day for the entire test period. The test equipment (Fig. 32) consists of large stationary painted aluminum alloy tanks with the specimens supported on an open aluminum alloy (6061-T6) framework that is raised and lowered to provide the alternate-immersion cycle.

The alternate-immersion test was conducted in a large laboratory room at ambient temperature and humidity. Both the air temperature and solution temperature were subject to seasonal variation, and ambient conditions had the typical ranges shown below.

| | | |
|---|---|---|
| May to September: | air temperature . . . . . . | 68 to 90 F |
| | solution temperature . . . | 64 to 72 F |
| | relative humidity . . . . . | 35 to 70% |
| October to April: | air temperature . . . . . . | 62 to 78 F |
| | solution temperature . . . | 58 to 68 F |
| | relative humidity . . . . . | 25 to 60% |

Measurements have shown that the temperature of the test specimens themselves remain within 2 to 3 degrees of the solution temperature throughout the drying cycle.

All specimens that failed during exposure were inspected visually, and representative failures were examined microscopically to verify that stress-corrosion cracking (SCC) was the cause of failure. In addition, the tensile specimens that did not fail during exposure were tension tested to determine the change in ultimate tensile strength caused by corrosion. For comparison, control specimens that had been concurrently exposed without stress were also tested.

Many years of experience at Alcoa Research Laboratories in stress-corrosion testing various products made of the alloys included in this program have shown that the 3.5% NaCl alternate-immersion test relates very well to seacoast atmospheric exposures(17). That is, test specimens stressed to various levels at which SCC occurs in the alternate-immersion test also will fail when exposed to a seacoast atmosphere, and test specimens that are resistant to SCC in the alternate-immersion test will be resistant in both seacoast and industrial atmospheres, also. A partial exception to the latter exists with 7079 alloy which, at low stress levels, has a higher probability of SCC in the atmosphere than in the 3.5% NaCl alternate-immersion test(18).

## B.2. Exfoliation

Because exfoliation of aluminum alloy forgings is relatively infrequent in service, exfoliation tests were restricted to only two sizes (2x8 in. and 6x24 in.) of forgings of each alloy.

Two panels, 4x6 in. in size, were machined from each forging. One panel was machined so as to place the test surface at 10 per cent of the forging thickness to represent parts which would receive slight machining, and the second panel was machined to mid-thickness (T/2 plane), to simulate extensively machined material.

The test panels were exposed at a 45 degree angle to an acidified salt spray in a cabinet designed to meet the requirements of ASTM Method B287-68 for acidified salt spray tests(19). The test conditions were the same as those required by ASTM except for the following variations which develop more severe exfoliation attack than the standard ASTM test:

(1) Operating temperature was 120 F, rather than 95 F.

(2) Specimens were intermittently sprayed in 6-hr repetitive cycles, consisting of 3/4-hr spray time, 2 hours of dry-air purge, 3-1/4 hours at 100-per cent relative humidity.

The specimens were inspected daily, and at the termination of the two-week exposure period, the panels were chemically cleaned and visually examined for evidence of exfoliation attack. Previous testing experience has shown that test results from this accelerated test can be correlated with exposure tests in a seacoast atmosphere(20).

## C. Fatigue-Crack-Propagation Tests

These tests were performed only on forgings of 6x24-in. cross section. Table XXXI gives the schedule of the tests, with pertinent information regarding type of notch, specimen proportions and orientation within the forging, test environment and the stress conditions under which cracks were propagated.

In previous tests of this kind on thick plate and extrusions (2,3 and 21), extensive use was made of the mild notch crack starter shown in Fig. 41. Because of the eccentric cracking often obtained, however, it was decided that a sharper notch should be tried. Details of a "sharp" notch are shown in Figs. 43 and and 44 for 24-in. and 6-in. long specimens. Comparative tests of the two notch designs in the 2014-T652 forging showed that crack initiation and propagation with the sharp notch was still not as uniform as desired. Accordingly, the Elox notch shown in Fig. 45 was adopted for the remainder of the program. With this design it was necessary to propagate a fatigue crack from the 0.2-in. initial notch width to a total of 0.5 in., where measurements of crack-propagation rates were begun. Crack initiation was produced by cycling the specimens to a maximum gross tensile stress of 12.5 ksi. The machine load was then adjusted, as scheduled, to the test stress and the cracking continued to produce a 0.5-in. notch length.

In a few tests, limited to the 2014-T652 forging, the maximum stress in the test cycle was increased, or decreased, after the total length of notch plus crack reached 1.0 in.

The majority of tests were made in laboratory air having a wide range of relative humidity. The humidity was monitored during each test and the range of values recorded. In a few tests made in a controlled atmospheric environment, the specimens were enclosed in the container shown in Fig. 46. Dry air, having a relative humidity of 10%, was obtained by use of a dessicant. High relative humidity, above 90%, was obtained by having a small water reservoir within the specimen enclosure. Salt fog was obtained by spraying a 35% NaCl sea-water solution into the container at 15-minute intervals. The humidity was maintained at a high level by means of salt water in the reservoir.

Crack-propagation characteristics were investigated in the three principal directions of the 7075-T7352 and 7079-T652 forgings. Also, specimens were taken from one skewed direction to provide a condition of grain runout. It was assumed, on the basis of the comparative tests of 6-in. and 24-in. long sharp-notched specimens, taken from the same direction in the 2014-T652 forging, that specimen length was not a significant factor in evaluating directional effects.

The fatigue-crack-propagation tests were made in machines of 50,000-lb capacity. Pictures of these, with some of the fixtures used, are shown in Figs. 47 and 48.

Crack propagation was deduced from lengths measured at the surfaces of the specimen with a magnifying glass and scale, the latter graduated in 0.01 in. More precise measurements did not seem justified because the cracks tended to propagate on a convex front.

## SECTION IV

## RESULTS OF TESTS

The results of the individual tensile, compressive, shear and bearing tests, the ratios among certain properties, the statistical analysis of these ratios, and the computed design values are presented in Tables II through XIX. The results of the stress-strain and modulus of elasticity tests are shown in Tables XX and XXI and in the stress-strain and compressive tangent-modulus curves in Figs. 11 through 18.

The results of the fracture-toughness tests are shown in Tables XXII and XXIII. The results of the axial-stress fatigue tests are shown in Table XXIV and in Figs. 19 through 22.

The results of the stress-corrosion tests are shown in Tables XXVI through XXX.

The results of the fatigue-crack propagation tests are presented in Figs. 49 to 109. For each condition studied, two plots are presented: the first is a plot of the crack-propagation data and the second is a plot of the fatigue-crack growth rate versus $\Delta K$, the range of stress-intensity factor for the same data. The crack-growth rates, $\frac{da}{dN}$*, were determined by computer from the slopes of the crack-propagation curves. The actual crack-propagation data for each specimen are given in the Appendix. Figs. 110 and 111 show a comparison of the crack-growth rates of these alloys and with those previously determined for thick specimens of plate and extrusions (2,3 and 21).

* a = 1/2 total crack length (notch length plus fatigue cracks);
N = number of cycles

## SECTION V

## DISCUSSION OF RESULTS

### A. Mechanical Properties

#### A.1. Tensile, Compressive, Shear and Bearing

The results of the tensile, compressive, shear and bearing tests of the individual samples of 2 to 6-in. thick 2014-T652, 2024-T852, 7075-T7352 and 7079-T652 hand forgings are summarized in Tables II through V. The tensile properties of each sample meet the applicable minimum-property requirements shown in Table VI.

The ratios among the properties determined for the individual samples are summarized in Table VII. The statistical analyses of the ratio data were made in accordance with the procedures outlined in Mil-Handbook-5 Guidelines for Presentation of Data(15).

A regression analysis of each group of ratios was made to determine whether the data showed a significant correlation with thickness. When a significant correlation with thickness was indicated, values of minimum-ratios, $\bar{R}$, were selected which correspond with the lower limit of the confidence band around the regression line at the mean of each respective thickness range. When no correlation was shown, a single minimum value of $\bar{R}$ was selected for all thicknesses. These values of minimum $\bar{R}$ were used for determining derived design values for the respective thickness ranges.

The distribution of the ratios, and the values for the various terms in the statistical analyses, are shown in Tables VIII to XI. Of the ratios involving compressive yield stresses, only those for 2024-T852 in the longitudinal and long-transverse directions show a correlation with thickness. There is no correlation with thickness indicated in the ratios involving shear and bearing stresses for any of the alloys investigated.

Since the shear and bearing tests were made with specimens taken in two or three directions (L, LT and ST), Student's "t" test and "f" test were applied to the ratios for each direction to determine if there were significant differences in the average ratios or in the variability for the different directions. Where none was indicated, the ratios for the different directions were combined for computation of the minimum ratios to be used; where there was a significant difference, the most conservative value was used.

The ratio values used in computing the design values from the specified tensile properties of the respective thickness ranges of each alloy are summarized in Tables XII to XV. The corresponding computed design values for each of the alloys are summarized in Tables XVI to XIX; also shown are the differences between these values and the corresponding values presently in MIL-HDBK-5A.

In preparing the design tables for 2014-T652, 7075-T7352 and 7079-T652, the respective tensile-property values in Federal Specification QQ-A-367g and Military Specification MIL-22771C, as shown in Table VI, were used as basis-property "S" values. The tentative values for 2024-T852 were based on the tensile data determined in this investigation and Alcoa production data. The basis-property values and the ratios shown in Tables XII to XV, were used in computing the remaining design values.

As shown in Tables XVI and XIX, the derived design values of compressive, shear and bearing properties for 2014-T652 and 7079-T652 hand forgings differ slightly from the values now published in MIL-HDBK-5A. For 2014-T652, the computed derived values of $F_{cy}$ (LT) are 1 ksi higher; the $F_{su}$ and $F_{bru}$ values, 2-3 ksi lower; the $F_{bry}$ values for e/D=1.5 are 1-2 ksi lower and for e/D=2.0, 1 ksi lower to 1 ksi higher. For 7079-T652, the computed derived values for $F_{cy}$ (L) are 2 ksi lower and those of $F_{su}$ are the same or 1 ksi lower. The slightly lower values of shear stresses developed in this contract may be partially explained by the fact that the loads in the shear tests were applied normal to the major surface of the hand forgings, whereas in previous tests, the loading direction was not controlled(11). No design values are presently shown for 2024-T852 and 7075-T7352 hand forgings in MIL-HDBK-5A.

The results of the individual tensile and compressive stress-strain tests and the modulus of elasticity tests are summarized in Table XX; the average modulus values are shown in Table XXI.

In the modulus tests, none of the alloys investigated showed any significant difference in modulus values that might be readily associated with thickness of sample or the specimen direction (L, LT or ST). The modulus of elasticity of each alloy is indicated to be three or four per cent higher in compression than in tension.

The average moduli for the two alloys of each series (2000 and 7000) were nearly equal; average tensile and compressive modulus values for the two series are:

| Alloy Series | Modulus, psi | |
|---|---|---|
| | Tension | Compression |
| 2000 | 10 500 000 | 10 800 000 |
| 7000 | 10 000 000 | 10 400 000 |

The average modulus values shown above for the 2000 alloy series (2014 and 2024) are the same for tension and 1 per cent higher for compression than the applicable values now shown in MIL-HDBK-5A, whereas the applicable values for the 7000 series (7075 and 7079) are slightly lower by 3 per cent in tension and 1 per cent in compression. These average values are 1 to 4 per cent lower than those obtained for stress-relieved plate and extrusions in previous contracts, Technical Reports AFML-TDR-64-105, May 1964, and AFML-TR-68-34, February 1968, respectively(1 and 4). The modulus values determined for the hand forgings are shown in Tables XVI to XIX, and were used in preparing the stress-strain and compressive tangent-modulus curves shown in Figs. 11 to 18.

The results of the individual stress-strain tests indicated that, for a given alloy, temper and direction, there was no apparent trend with thickness in the offsets from the modulus line at stresses expressed in per cent of yield stress. Typical and minimum ("S" value) stress-strain and compressive tangent-modulus curves have been prepared for the alloys in thickness ranges as shown in Figs. 11 to 18. The curves were derived and presented in accordance with the procedures outlined in MIL-HDBK-5 Guidelines for Presentation of Data(15). The tensile yield stresses used in deriving the typical stress-strain curves are the typical values indicated in Alcoa's production in recent years; it is assumed that these values would be representative for the industry. The compressive yield stresses were based on the average ratios shown in Tables XII to XV. For the minimum stress-strain curves, the tensile and compressive yield stress values shown for the appropriate thickness range in Tables XVI to XIX were used.

## A.2. Fracture Toughness

The results of the individual fracture toughness tests are shown in Table XXII. Although some of the values are not strictly valid by all of the criteria of the ASTM Recommended Method of Test for Plane-Strain Fracture Toughness of Metallic Materials(16), most of the calculated $K_Q$ values are considered to be meaningful values of $K_{Ic}$ since certain

criteria were exceeded only by a small amount, as indicated in the table. With but two exceptions, meaningful $K_{Ic}$ values were obtained for all of the contract materials in the different directions. The data indicate that the fracture toughness of each alloy is greater in the longitudinal (LW) direction than in the long-transverse (WL) direction and least in the short-transverse (TL) direction.

The meaningful values of $K_{Ic}$ from Table XXII are summarized in Table XXIII. The fracture toughness values determined for 2014-T652, 2024-T852 and 7079-T652 indicate no definite trend with thickness, however, the values for 7075-T7352, in each direction, show a tendency to increase with increased thickness.

Also included for comparison are the average fracture toughness values determined for some extrusions (TX510 tempers) in a previous contract(4). In most instances, the respective average values shown for the hand forgings and the extrusions are in good agreement; there are large differences (in excess of 10 per cent) between the long-transverse values for alloys 2014 and 7079, with the hand forgings having the lower values. It is pointed out, however, that the values shown for the 2014 and 7079 extrusions are based on duplicate tests of only one sample of material, whereas the values for the 2024 and 7075 extrusions are based on tests of 4 to 6 samples.

## A.3. Axial-Stress Fatigue

The results of the axial-stress fatigue tests (R=0.0) of long-transverse specimens from the 2, 4, 5 and 6-in. thick forgings are shown in Table XXIV and in Figs. 19 to 22. Log-mean fatigue life values for two of the three preselected stress levels, at which the respective alloys were tested, are shown in the table; the curves have been drawn through these points and extended to indicate the trend of the data. Log-mean lives could not be calculated for the lowest stress because, for each alloy, at least one specimen did not fail within the number of cycles allotted to the test.

The test results for all four alloys indicate that there may be a correlation between the fatigue life and thickness of the hand-forging sample; in most of the tests, at all three stress levels, fatigue life decreased with increase in forging thickness.

To allow comparison, the fatigue curves determined for plate and extrusions in previous investigations (2,3,4) are also plotted in Figs. 19 to 22. In general, the log-mean

| Alloy Series | Modulus, psi | |
|---|---|---|
| | Tension | Compression |
| 2000 | 10 500 000 | 10 800 000 |
| 7000 | 10 000 000 | 10 400 000 |

The average modulus values shown above for the 2000 alloy series (2014 and 2024) are the same for tension and 1 per cent higher for compression than the applicable values now shown in MIL-HDBK-5A, whereas the applicable values for the 7000 series (7075 and 7079) are slightly lower by 3 per cent in tension and 1 per cent in compression. These average values are 1 to 4 per cent lower than those obtained for stress-relieved plate and extrusions in previous contracts, Technical Reports AFML-TDR-64-105, May 1964, and AFML-TR-68-34, February 1968, respectively(1 and 4). The modulus values determined for the hand forgings are shown in Tables XVI to XIX, and were used in preparing the stress-strain and compressive tangent-modulus curves shown in Figs. 11 to 18.

The results of the individual stress-strain tests indicated that, for a given alloy, temper and direction, there was no apparent trend with thickness in the offsets from the modulus line at stresses expressed in per cent of yield stress. Typical and minimum ("S" value) stress-strain and compressive tangent-modulus curves have been prepared for the alloys in thickness ranges as shown in Figs. 11 to 18. The curves were derived and presented in accordance with the procedures outlined in MIL-HDBK-5 Guidelines for Presentation of Data(15). The tensile yield stresses used in deriving the typical stress-strain curves are the typical values indicated in Alcoa's production in recent years; it is assumed that these values would be representative for the industry. The compressive yield stresses were based on the average ratios shown in Tables XII to XV. For the minimum stress-strain curves, the tensile and compressive yield stress values shown for the appropriate thickness range in Tables XVI to XIX were used.

## A.2. Fracture Toughness

The results of the individual fracture toughness tests are shown in Table XXII. Although some of the values are not strictly valid by all of the criteria of the ASTM Recommended Method of Test for Plane-Strain Fracture Toughness of Metallic Materials(16), most of the calculated $K_Q$ values are considered to be meaningful values of $K_{Ic}$ since certain

criteria were exceeded only by a small amount, as indicated in the table. With but two exceptions, meaningful $K_{Ic}$ values were obtained for all of the contract materials in the different directions. The data indicate that the fracture toughness of each alloy is greater in the longitudinal (LW) direction than in the long-transverse (WL) direction and least in the short-transverse (TL) direction.

The meaningful values of $K_{Ic}$ from Table XXII are summarized in Table XXIII. The fracture toughness values determined for 2014-T652, 2024-T852 and 7079-T652 indicate no definite trend with thickness, however, the values for 7075-T7352, in each direction, show a tendency to increase with increased thickness.

Also included for comparison are the average fracture toughness values determined for some extrusions (TX510 tempers) in a previous contract(4). In most instances, the respective average values shown for the hand forgings and the extrusions are in good agreement; there are large differences (in excess of 10 per cent) between the long-transverse values for alloys 2014 and 7079, with the hand forgings having the lower values. It is pointed out, however, that the values shown for the 2014 and 7079 extrusions are based on duplicate tests of only one sample of material, whereas the values for the 2024 and 7075 extrusions are based on tests of 4 to 6 samples.

## A.3. Axial-Stress Fatigue

The results of the axial-stress fatigue tests (R=0.0) of long-transverse specimens from the 2, 4, 5 and 6-in. thick forgings are shown in Table XXIV and in Figs. 19 to 22. Log-mean fatigue life values for two of the three preselected stress levels, at which the respective alloys were tested, are shown in the table; the curves have been drawn through these points and extended to indicate the trend of the data. Log-mean lives could not be calculated for the lowest stress because, for each alloy, at least one specimen did not fail within the number of cycles allotted to the test.

The test results for all four alloys indicate that there may be a correlation between the fatigue life and thickness of the hand-forging sample; in most of the tests, at all three stress levels, fatigue life decreased with increase in forging thickness.

To allow comparison, the fatigue curves determined for plate and extrusions in previous investigations (2,3,4) are also plotted in Figs. 19 to 22. In general, the log-mean

fatigue values of the hand forgings are about the same or slightly higher than those of the extrusions, and somewhat lower than those of plate of the corresponding alloy and temper. However, at the lower stress level, the fatigue life for 2024-T852 hand forgings is indicated to be substantially greater than those of both 2024-T851 plate and 2024-T851X extrusions.

## B. Corrosion Characteristics

### B.1. Resistance to Stress Corrosion Cracking (SCC)

The data obtained from tests of longitudinal and long-transverse 0.437-in. diameter tensile specimens are given in Tables XXVI and XXVII, and similar data from tests of short-transverse 0.125-in. diameter tensile specimens are given in Tables XXVIII and XXIX. Supplemental test data (retests) for selected forgings are given in Table XXX.

A high resistance to stress-corrosion cracking was exhibited by longitudinal specimens from each of the forgings tested. Long-transverse specimens from the 2024-T852 and 7075-T7352 alloy forgings were also highly resistant to SCC, but long-transverse specimens from the 2014-T652 and 7079-T652 were generally susceptible (Figs. 33-36) at stresses equal to 75% of yield strength. These results generally are in good agreement with existing stress-corrosion guidelines for these forged products.

Tests of the short-transverse specimens showed good agreement with expected performance of the various alloys and tempers; i.e., the 7075-T7352 specimens, in general, were highly resistant to stress-corrosion cracking, the 2024-T852 specimens showed some susceptibility at high stresses only, and the 2014-T652 and 7079-T652 specimens were susceptible at relatively low levels of stress. Some nontypical behavior was observed, however, and limited supplemental testing was conducted to check the initial results.

The performance of short-transverse specimens from the 2, 3 and 5-in. thick 2014-T652 and 7079-T652 alloy forgings was better than that previously observed with forgings of these alloys, but was within the sphere of existing data for these materials. Retests with specimens from the 2-in. thick forgings showed these alloys to be susceptible to SCC at a stress of 22.5 ksi, while neither alloy had failed at that stress during initial testing. The 2014-T652 specimens also failed at a stress of 15 ksi during these retests. The retest data better typify the expected performance of these forgings.

In comparing the initial and supplementary test results (Table XXX) for the 2-in. thick 2014-T652 and 7079-T652 forgings, it was observed that the two tests had been conducted during different seasons of the year. The initial tests were conducted during the winter months (November - February), and the retests during the summer months (July - October). The data strongly suggest that tests conducted under ambient conditions can be significantly influenced by seasonal variations.

Failures were encountered at 75% YS of short-transverse specimens from the 3 and 4-in. thick 7075-T7352 forgings. For the 4-in. thick 7075-T7352 forging, 1 of 3 specimens failed after an exposure of 64 days; however, metallographic examination revealed that the failure was not typical of stress-corrosion cracking (Figs. 37 and 38). Three specimens from the 3-in. thick forging failed after only 8 days exposure, and microscopic examination showed the failures to be typical of stress-corrosion cracking (Figs. 39 and 40). Although Federal Specification QQ-A-367g does not list stress-corrosion cracking criteria for 7075-T7352 alloy forgings, the new edition of MIL-A-22771C does require that the criteria specified for 7075-T73 forgings also be applied to forgings in the T7352 temper. These criteria state that short-transverse specimens stressed at 75 per cent of the minimum longitudinal yield strength shall satisfactorily complete a 30-day exposure in the 3.5% NaCl alternate immersion. On the basis of the strengths listed in "Aluminum Standards and Data", April, 1968, the test stress for a 3-in. thick forging would be 39.7 ksi. Hence, the 3-in. thick hand forging did not fulfill the stress-corrosion cracking requirements of the Military Specification MIL-A-22771C. The forging, therefore, cannot be considered to represent the T7352 temper from the standpoint of corrosion resistance. This is surprising because the forging met the electrical conductivity - yield strength criterion, though in borderline fashion, for adequate resistance to stress-corrosion cracking.

B.2. Resistance to Exfoliation

No exfoliation was detected on the panels exposed to the acidified intermittent spray regardless of alloy, and no significant differences were observed between specimens from different regions (T/10, T/2) relative to the forging thickness.

## C. Fatigue-Crack Propagation

### C.1. Tests of 2014-T652 Hand Forging

The 2014-T652 specimens were selected to investigate, for one orientation in the forging, the effects of (1) notch shape, (2) specimen length and (3) change of load on crack-propagation rates. These results are presented in Figs. 49 to 67. Although the sharp notches produced somewhat more symmetrical cracking than the mild notches, the crack-growth rates were not significantly different.

The results for this alloy show a surprisingly large amount of scatter, which may have obscured the effects of some of the test variables. The fracture surfaces of the mild-notched specimens, 7 and 10, which showed a large difference in crack-growth rate, were visibly different, as were those of the adjacent sharp-notched specimens, 8 and 11. Cross sections near the fracture surfaces of specimens 7 and 10 are shown in Fig. 57; Specimen 7 shows a directional or fibrous-type fracture whereas specimen 10, which had a higher crack-propagation rate, shows a coarse, nonfibrous fracture. These specimens were taken from the same central portion of the forging cross section at locations only 3 in. apart.

The results for specimens of 6-in. and 24-in. lengths do not show consistent differences in crack-growth rates for the loadings investigated. Thus, it appears that variations in specimen length do not have to be taken into account in evaluating crack-propagation behavior.

Rates of crack propagation were influenced, of course, by the loadings applied. Increasing or decreasing the load after reaching a total crack length of 1.0 in., however, had no apparent effect on growth rates at the new loads. That is, propagation at low stresses did not influence subsequent rates at higher stresses, and vice versa.

One variable listed in Figs. 49 to 67, referred to above, is the range of relative humidity existing in the laboratory during the tests. These generally ranged from 5 to 90 per cent. Although it appears in some cases that rate of cracking increased with increasing humidity, all results are not consistent in this respect.

### C.2. Tests of 2024-T852 Hand Forging

Tests of this alloy were limited to specimens of one orientation at three different stress levels. Results are presented in Figs. 68 and 69. In contrast to the results shown for the 2014-T652 forging, the crack-propagation data for duplicate specimens at any one stress are quite consistent.

This is attributed in part to the use of the Elox notch. Fig. 69 shows excellent correlation between propagation rates for stress levels of 8.2 ksi and 12.5 ksi. The tests at 17.5 ksi show a higher rate of propagation for the same stress-intensity factors.

## C.3. Tests of 7075-T7352 and 7079-T652 Forgings

Crack-propagation was investigated in seven directions in these forgings, at one to three stress levels, and in different controlled environments. Results are presented in Figs. 70 to 109.

For both alloys, there was fairly good agreement between crack-growth rates at the different stress levels. Alloy 7075-T7352 was generally more resistant to crack propagation than 7079-T652. Short-transverse specimens in both alloys cracked more rapidly than those from the other orientations. Propagation in the face specimens tended to be slightly faster than in the edge specimens.

Environment was shown to have a significant effect on crack-growth rates. Both alloys cracked more rapidly in the high humidity tests, but 7079-T652 was affected more than 7075-T7352. The salt fog was slightly more damaging than high humidity.

Figures 106 to 109 show that the rate of cycling did not appreciably affect the rate of fatigue-crack propagation of 7075-T7352 and 7079-T652 LT(E) specimens in the salt-fog atmosphere.

## C.4. Comparison of Alloys

Figure 110 compares the average crack-progation rates for long-transverse edgewise specimens of the four alloys. At the lower stress intensities, the propagation was slowest for alloy 2014-T652 but at the highest stress intensities propagation was fastest for this alloy. Some of this difference is due to the greater eccentricity of cracking in the 2014-T652 specimens. For these long-transverse specimens, propagation for alloy 2024-T852 was consistently slower than for alloys 7075-T7352 and 7079-T652. This is contrary to the findings of Ref. 3 which rated 7075-T7351 plate above 2024-T851 plate from the standpoint of resistance to fatigue-crack propagation.

Figure 111 compares the propagation rates for longitudinal specimens of several 7075-T73XX and 7079-T6XX products. The data are consitent in showing 7075-T73XX to have lower propagation rates than alloy 7079-T6XX. The agreement between the rates for the various 7075-T73XX products is better than that shown for 7079-T6XX products.

## SECTION VI

## SUMMARY AND CONCLUSIONS

Based on the results of tests of commercially-produced hand forgings that met the requirements for composition and tensile properties in applicable Federal and Military specifications, the following conclusions seem warranted concerning the mechanical properties, including fracture toughness and fatigue strengths, resistance to stress-corrosion and exfoliation and fatigue-crack propagation rates of stress-relieved 2014-T652, 2024-T852, 7075-T7352 and 7079-T652 hand forgings:

1. Ratios among the tensile, compressive, shear and bearing properties are shown in Table VII.

2. For 2014-T652, 7075-T7352 and 7079-T652, these ratios among properties do not indicate a significant variation with thickness.

3. For 2024-T852, only the ratios involving longitudinal and long-transverse compressive yield stresses show a correlation with thickness; the ratios decrease with increase of thickness.

4. Ratios used in computing the design mechanical properties are as shown in Tables XII to XV. The ratios are applicable for computing properties in the L, LT and ST directions and for thicknesses ranging up through 6 in.

5. Computed design mechanical properties for the respective alloys are as shown in Tables XVI to XIX. These values for 2014-T652 and 7079-T652 are no more than 1 ksi higher or 3 ksi lower than the respective values now published in MIL-HDBK-5A. No values are published in MIL-HDBK-5A for 2024-T852 or 7075-T7352 hand forgings.

6. The modulus of elasticity of each alloy is 3 or 4 per cent higher in compression than in tension. The values for the alloys in the respective 2000 and 7000 series are approximately the same regardless of test direction (L, LT and ST), sample thickness and temper.

7. The average modulus values, for all directions, are:

| Alloy Series | Modulus, psi | |
|---|---|---|
| | Tension | Compression |
| 2000 | 10 500 000 | 10 800 000 |
| 7000 | 10 000 000 | 10 400 000 |

8. Typical and minimum ("S" value) stress-strain and compressive tangent-modulus curves are shown in Figs. 11 to 18.

9. The average values of plane-strain stress-intensity factor, $K_{Ic}$ (psi$\sqrt{\text{in.}}$), at 5-per cent secant offset are as follows:

| Alloy and Temper | Longitudinal (LW) | Long-Transverse (WL) | Short-Transverse (ST) |
|---|---|---|---|
| 2014-T652 | 28 800 | 21 600 | 20 500 |
| 2024-T852 | 26 300 | 18 400 | 15 900 |
| 7075-T7352 | 34 000 | 25 900 | 20 800 |
| 7079-T652 | 27 600 | 23 000 | 18 100 |

10. The results of the axial-stress fatigue tests (R=0.0) are plotted in Figs. 19 to 22. For 2014-T652, 7075-T7352 and 7079-T652, the log-mean fatigue lives of the respective hand forging alloys are about the same or slightly higher than those of extrusions, and slightly lower than those of plate of corresponding alloys and tempers tested in previous investigations. For 2024-T852 hand forgings, the log-mean fatigue lives at the higher stresses are about the same as those of both 2024-T851 plate and 2024-T851X extrusions; at the lower stress level, the fatigue life is substantially greater than those of the plate and extrusions.

11. All forgings were resistant to stress-corrosion cracking when longitudinally stressed to 75% of longitudinal yield strength. Long-transverse specimens stressed to 75% of long-transverse yield strength also were resistant in the case of 2024-T852 and 7075-T7352 but were generally susceptible in the case of 2014-T652 and 7079-T652; long-transverse specimens of 2014-T6 and 7079-T6 were resistant at stresses of 50% YS.

12. The resistance to stress-corrosion cracking of short-transverse specimens ranged widely with the alloy and temper: 7075-T7352 was resistant at 75% YS (except for the nontypical 3-in. thick forging); 2024-T852 was susceptible at

75% YS, but generally resistant at 50% YS; 7079-T652 and 2014-T652 were generally susceptible at 15 ksi (approximately 25% YS).

13. There was no indication that the resistance to SCC of any of the alloys was influenced by forging section thickness.

14. All alloys and tempers demonstrated a high resistance to exfoliation corrosion.

15. The most consistent fatigue-crack growth rates were obtained in the tests of specimens having the Elox crack starter (Fig. 45).

16. Short-transverse specimens showed somewhat higher crack-growth rates than specimens from other directions in the forgings.

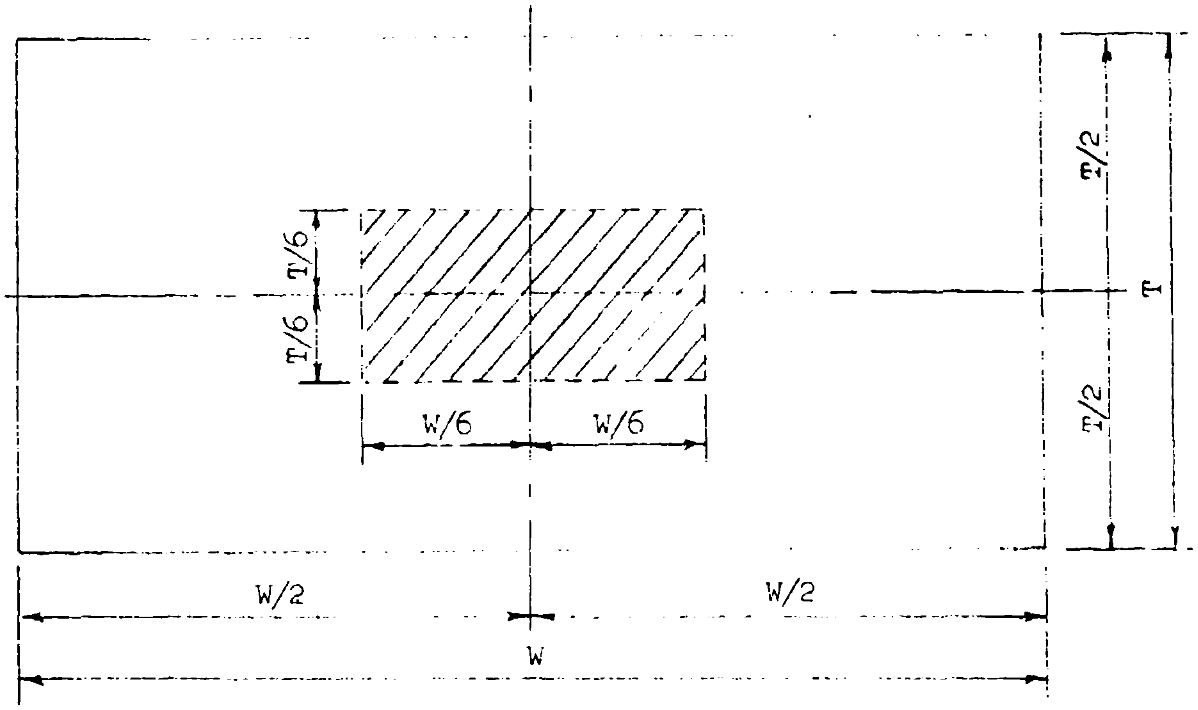
17. Tests in a high humidity produced higher crack-growth rates than tests in dry air. A salt-fog environment was slightly more damaging than high humidity.

18. At the lower stress intensities, the tests would rate these forging alloys in the following decreasing order of resistance to fatigue-crack propagation:

2014-T652
2024-T852
7075-T7352
7079-T652

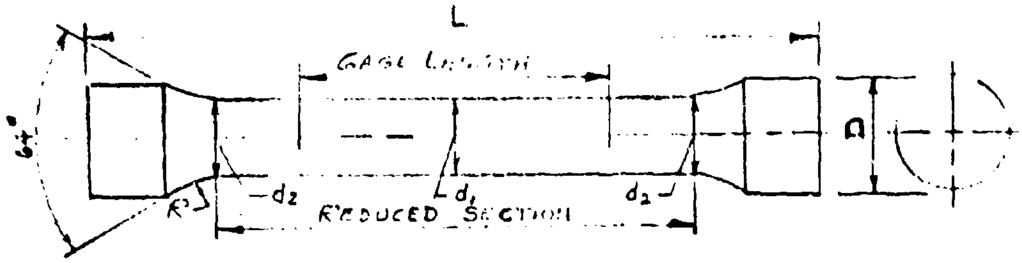
However, at the high stress intensities, propagation was fastest for alloy 2014-T652.

19. The crack-growth rates for the 7075-T7352 forging were consistent with those obtained in previous tests for 7075-T7351 plate and 7075-T73510 extrusions.



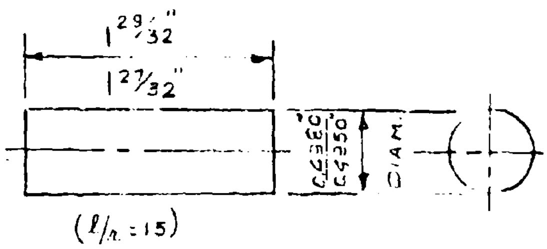

NOTE: Test Sections of All Specimens Were Within Center Third of Width and Thickness (cross-hatched area).

Fig. 1 Location of Test Sections of Specimens In Cross-Section of Hand Forgings.

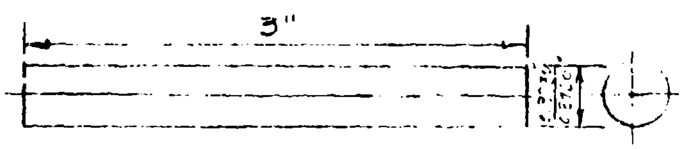



| DIAMETER, IN. $d_1$ | $d_2$ | GAGE LENGTH, IN. | REDUCED SECTION LENGTH, IN. | RADIUS (R), IN. | DIAMETER (D), IN. | LENGTH (L), IN. |
|---|---|---|---|---|---|---|
| $0.500 \pm 0.005$ | $d_1 + \frac{0.005}{0.003}$ | $2.000 \pm 0.002$ | $3\frac{1}{8}$ | $\frac{5}{8}$ | $\frac{3}{4}$ | $4\frac{3}{4}$ |
| $0.357 \pm 0.004$ | $d_1 + \frac{0.004}{0.003}$ | $1.400 \pm 0.002$ | $2\frac{15}{64}$ | $\frac{17}{64}$ | $\frac{17}{32}$ | $3\frac{5}{8}$ |
| $0.250 \pm 0.003$ | $d_1 + \frac{0.002}{0.001}$ | $1.000 \pm 0.002$ | $1\frac{9}{16}$ | $\frac{3}{16}$ | $\frac{3}{8}$ | $2\frac{3}{8}$ |
| $0.160 \pm 0.002$ | $d_1 + \frac{0.002}{0.001}$ | $0.640 \pm 0.002$ | $1$ | $0.120$ | $\frac{15}{64}$ | $1\frac{1}{2}$ |

Tapered-Seat Tensile Specimens




Round Compressive Specimen




Shear Specimen

Fig. 2 General Dimensions of Tensile, Compressive and Shear Specimens

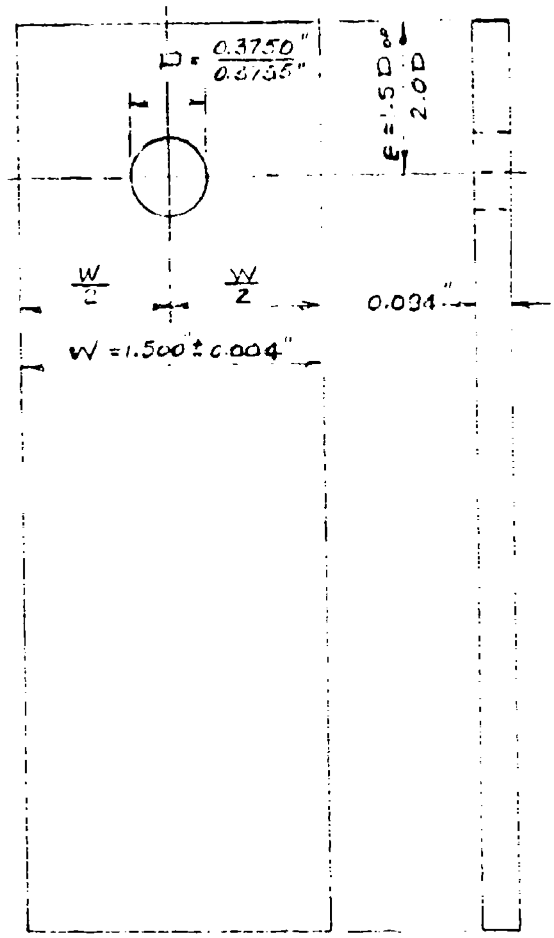
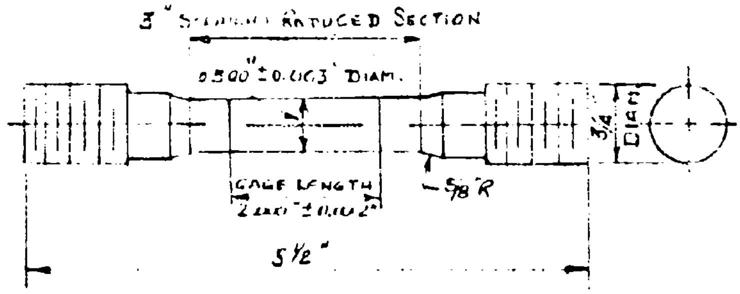
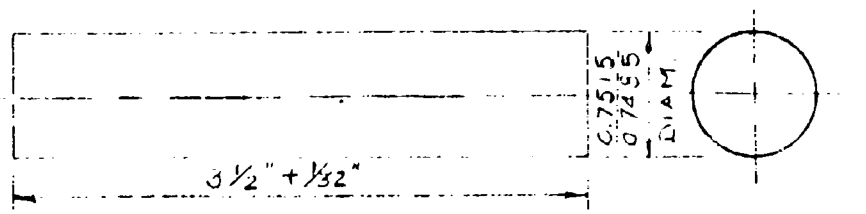



Fig. 3 General Dimensions of Bearing Specimens

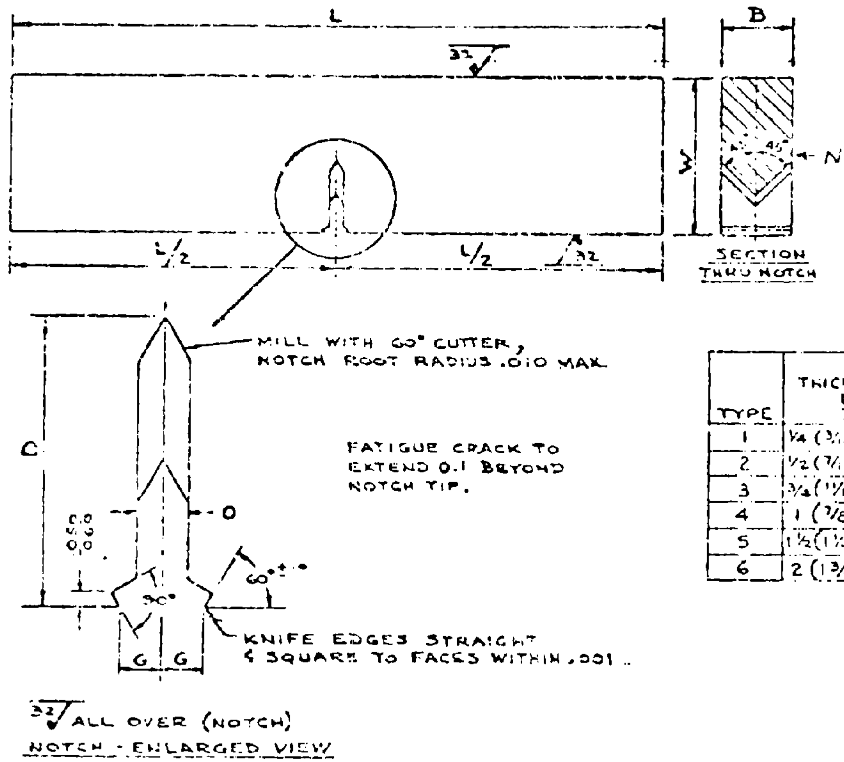



Round Tensile Specimen



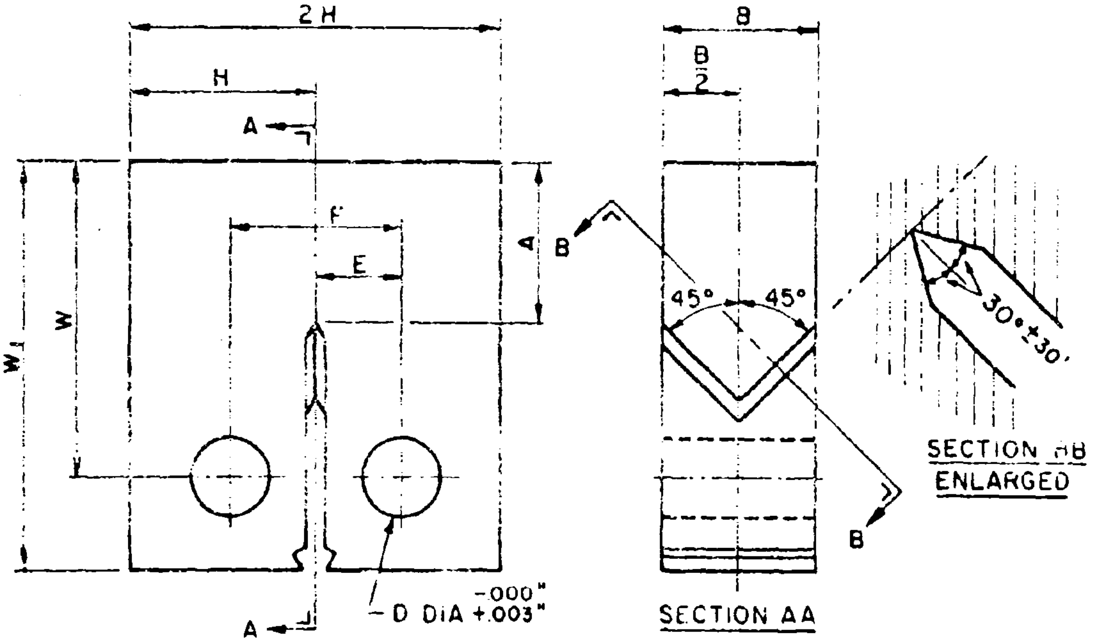

Round Compressive Specimen

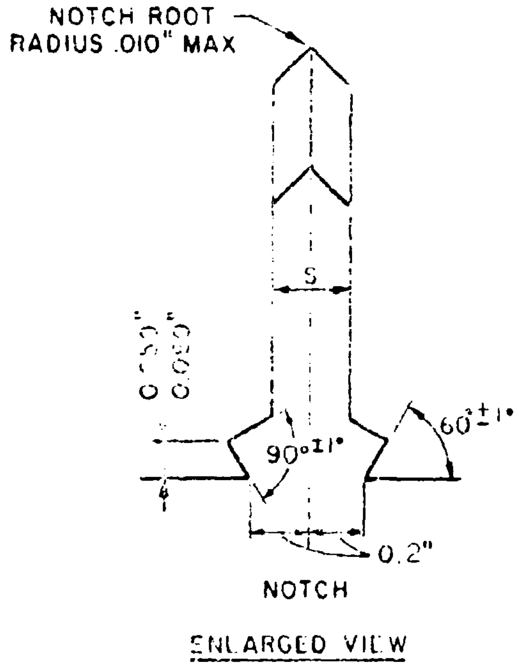
Fig. 4 General Dimensions of Tensile and Compressive Specimens For Modulus and Stress-Strain Tests




| TYPE | THICKNESS IN. B | DEPTH IN. W | SPECIMEN LENGTH IN. L | NOTCH DEPTH IN. D | NOTCH OPENING IN. O | GAP WIDTH IN. G |
|---|---|---|---|---|---|---|
| 1 | 1/4 (3/16-3/16) | 1/2 | 3 | 0.22 (±0.01) | 1/8 (0.120-0.125) | 0.095-0.100 |
| 2 | 1/2 (7/16-5/[illegible]) | 1 | 5 | 0.40 (±0.01) | 1/8 | |
| 3 | 3/4 (11/16-13/[illegible]) | 1 1/2 | 7 | 0.65 | 1/8 | |
| 4 | 1 (7/8-1 1/[illegible]) | 2 | 9 | 0.90 | 1/8 | |
| 5 | 1 1/2 (1 1/4-1 3/[illegible]) | 3 | 13 | 1.40 (±0.02) | 1/4 (0.245-0.250) | 0.195-0.200 |
| 6 | 2 (1 3/4-2 1/[illegible]) | 4 | 17 | 1.90 | 1/4 | |

Fig. 5 Notch-Bend Fracture Toughness Specimens




| PROPORTIONS | DIMENSIONS, IN. |
|---|---|
| B = THICKNESS | 1.000 |
| A = 1.1B | 1.10 |
| W = 2B; $W_1$ = 2.5B | 2.000; 2.500 |
| S - 0.1B | 0.125 |
| F = 2E = 1.10B | 1.100 |
| H = 1.2B | 1.200 |
| D = 0.5B | 0.500 |

Fig. 6 COMPACT TENSION FRACTURE TOUGHNESS SPECIMEN

Fig. 7 Cantilever Beam Setup for Fatigue Cracking Notch-Bend Fracture Toughness Specimens

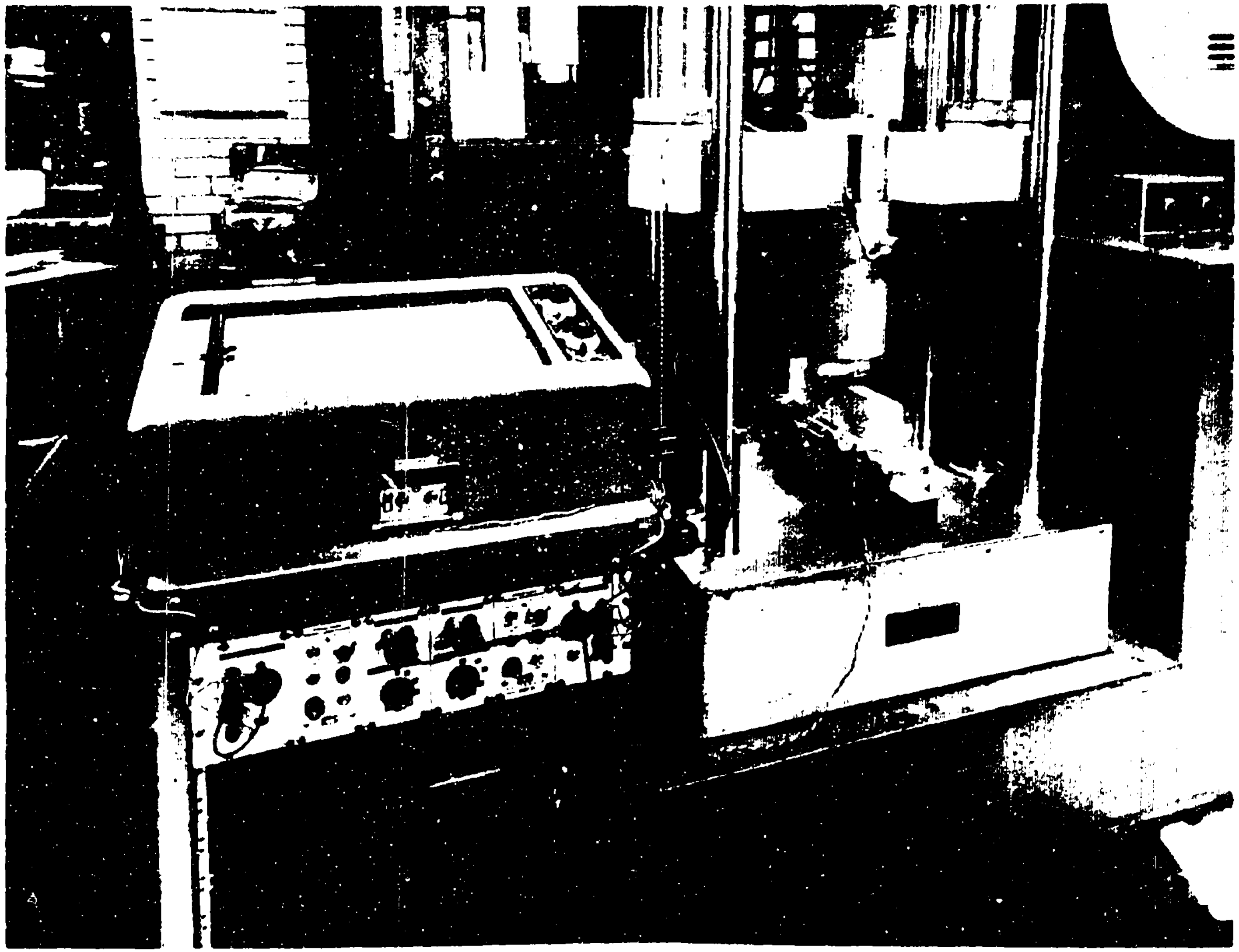


Fig. 8 Setup For Notch-Bend Fracture Toughness Testing

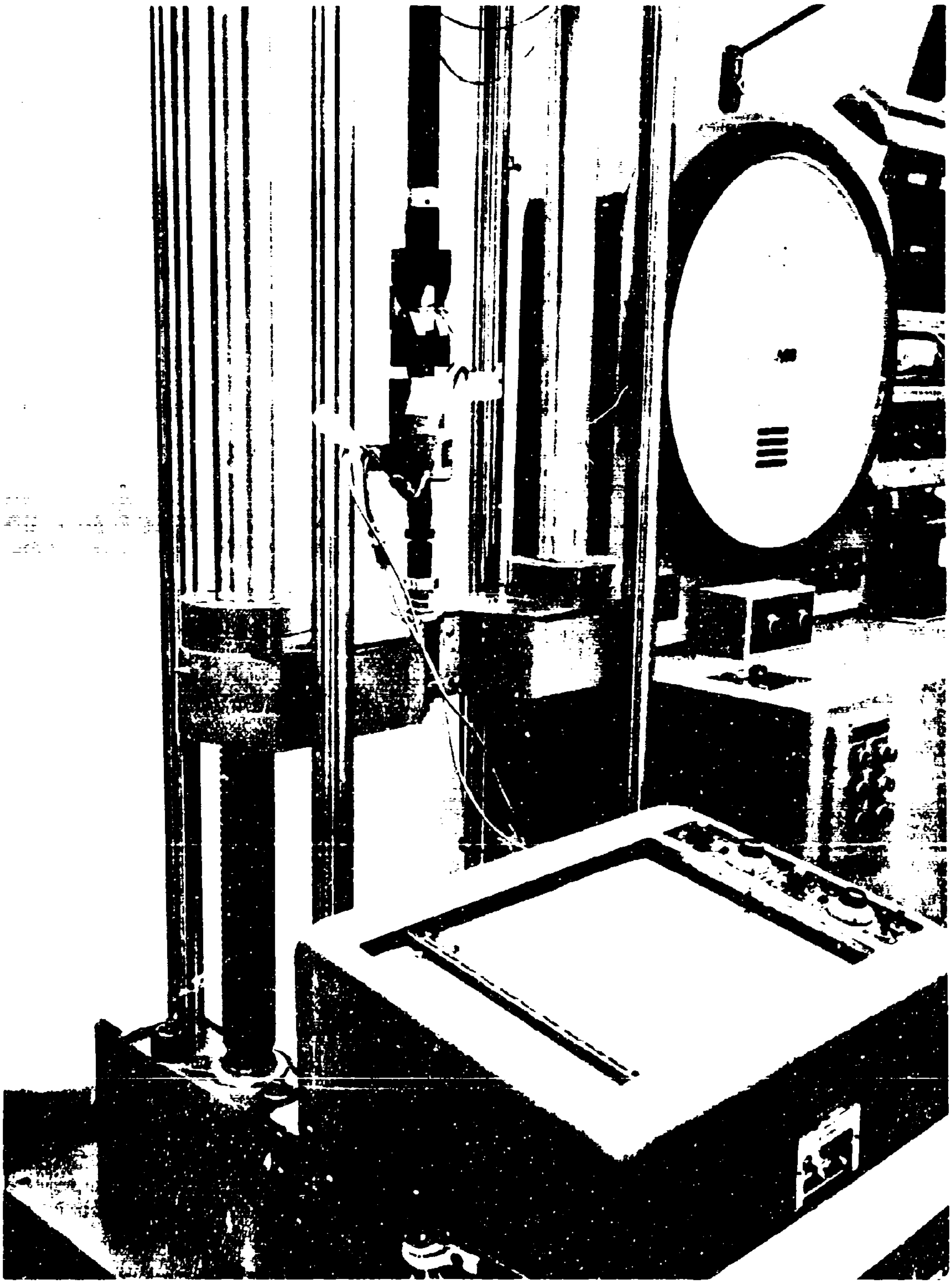


Fig. 9   Setup for Comp ct Tension Fracture Toughness Testing

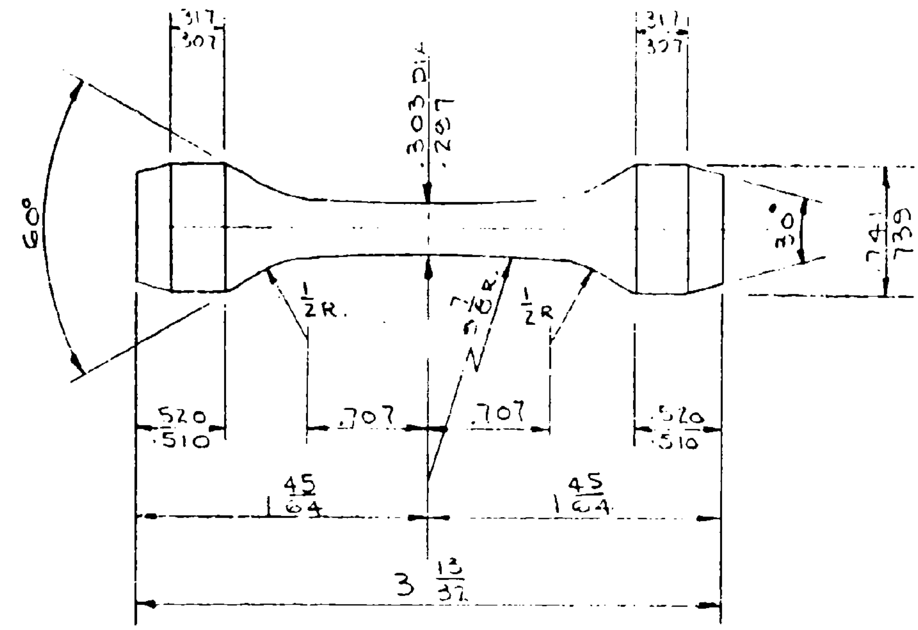


Fig. 10    Axial-Stress Fatigue Specimen

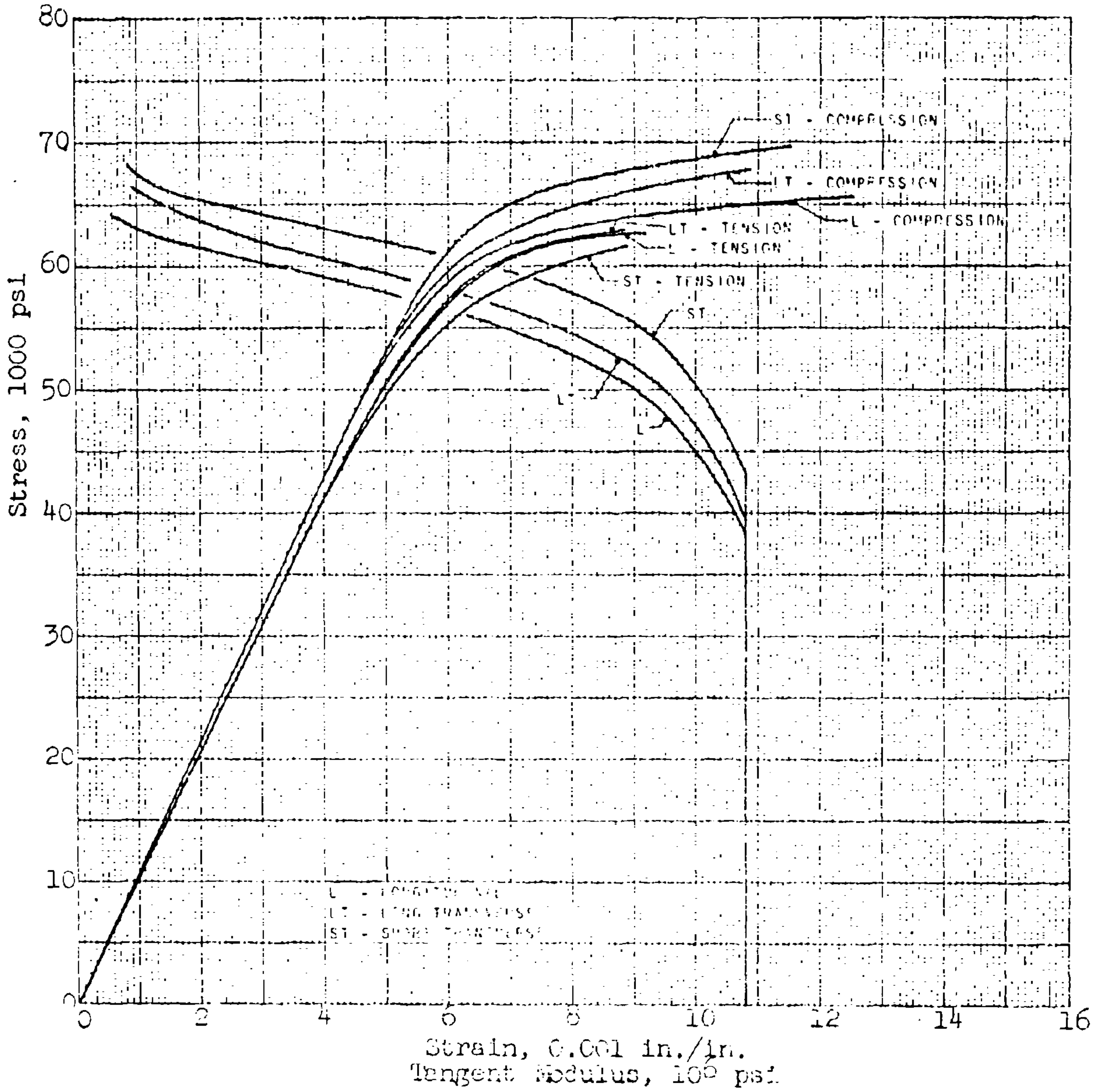



Fig. 11 Typical Stress-Strain and Compressive Tangent-Modulus Curves for 2014-T652 Aluminum Alloy Hand Forgings, 2.001-3.000 in.

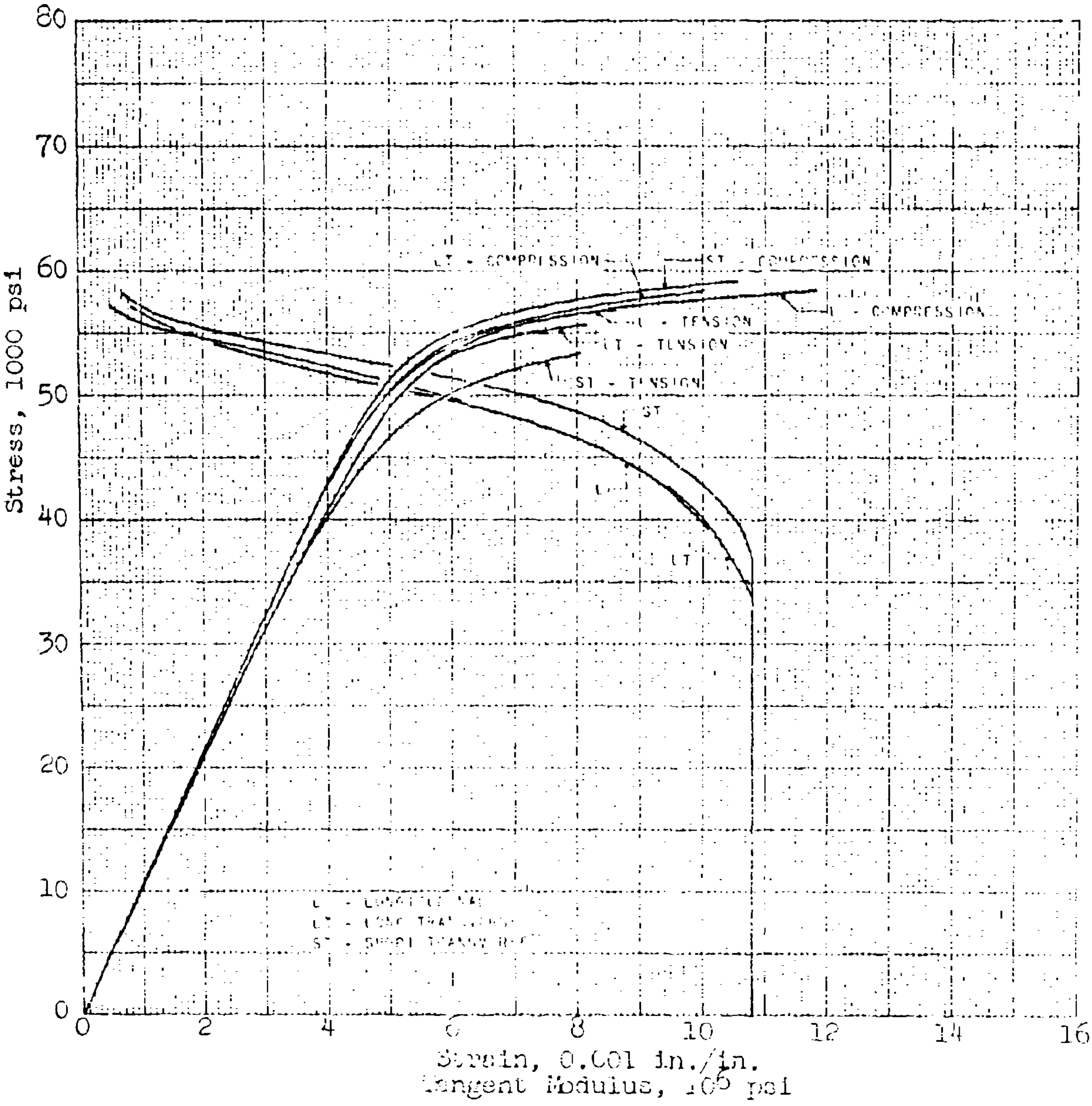



Fig. 12 Minimum ("B" Value) Stress-Strain and Compressive Tangent-Modulus Curves for 2014-T652 Aluminum Alloy Hand Forgings, 2.001-3.000 in.

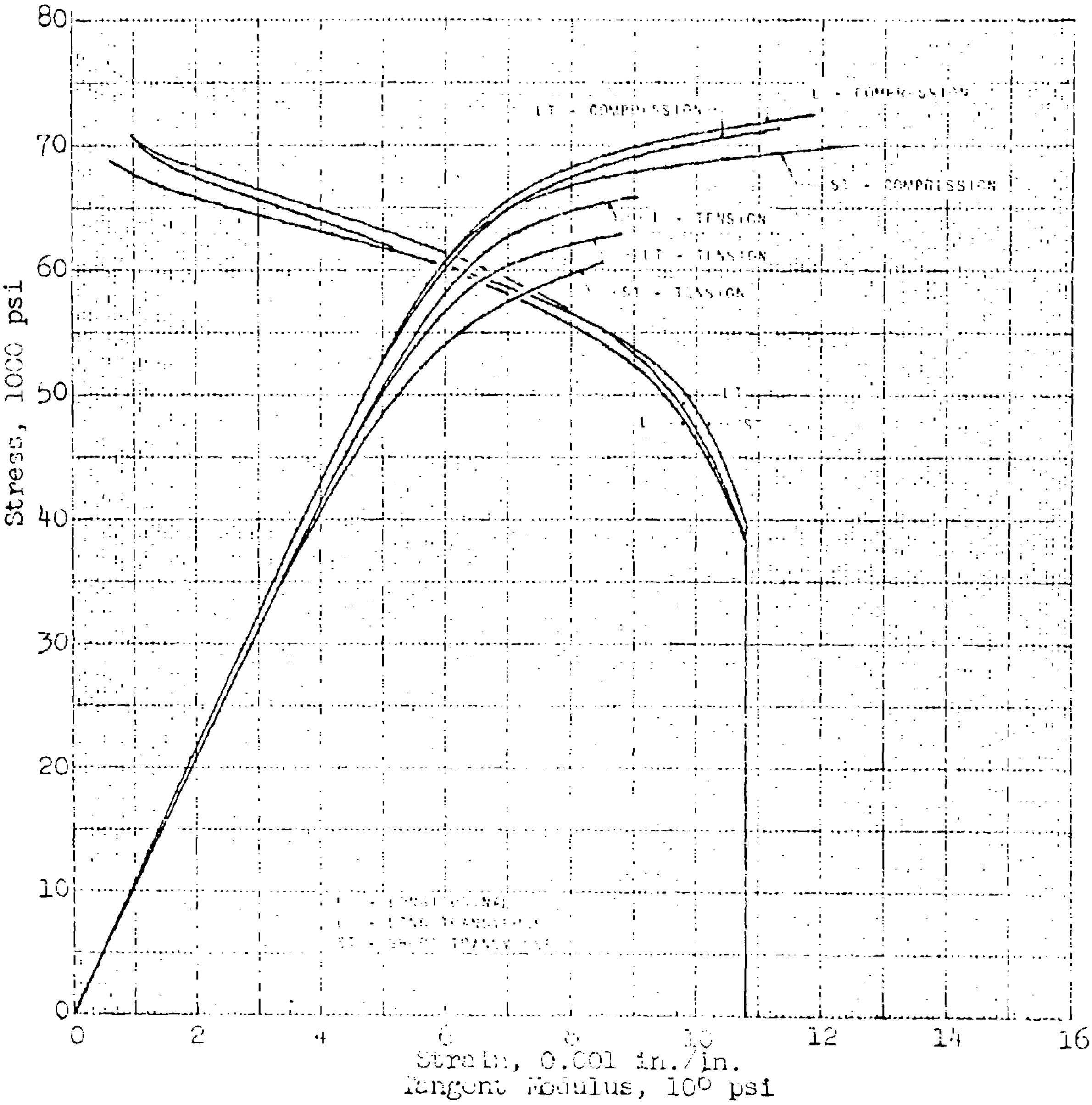



Fig. [illegible] Tentative Typical Stress-Strain and Compressive Tangent-Modulus Curves for 2024-T852 Aluminum Alloy Hand Forgings, 2.001-3.000 in.

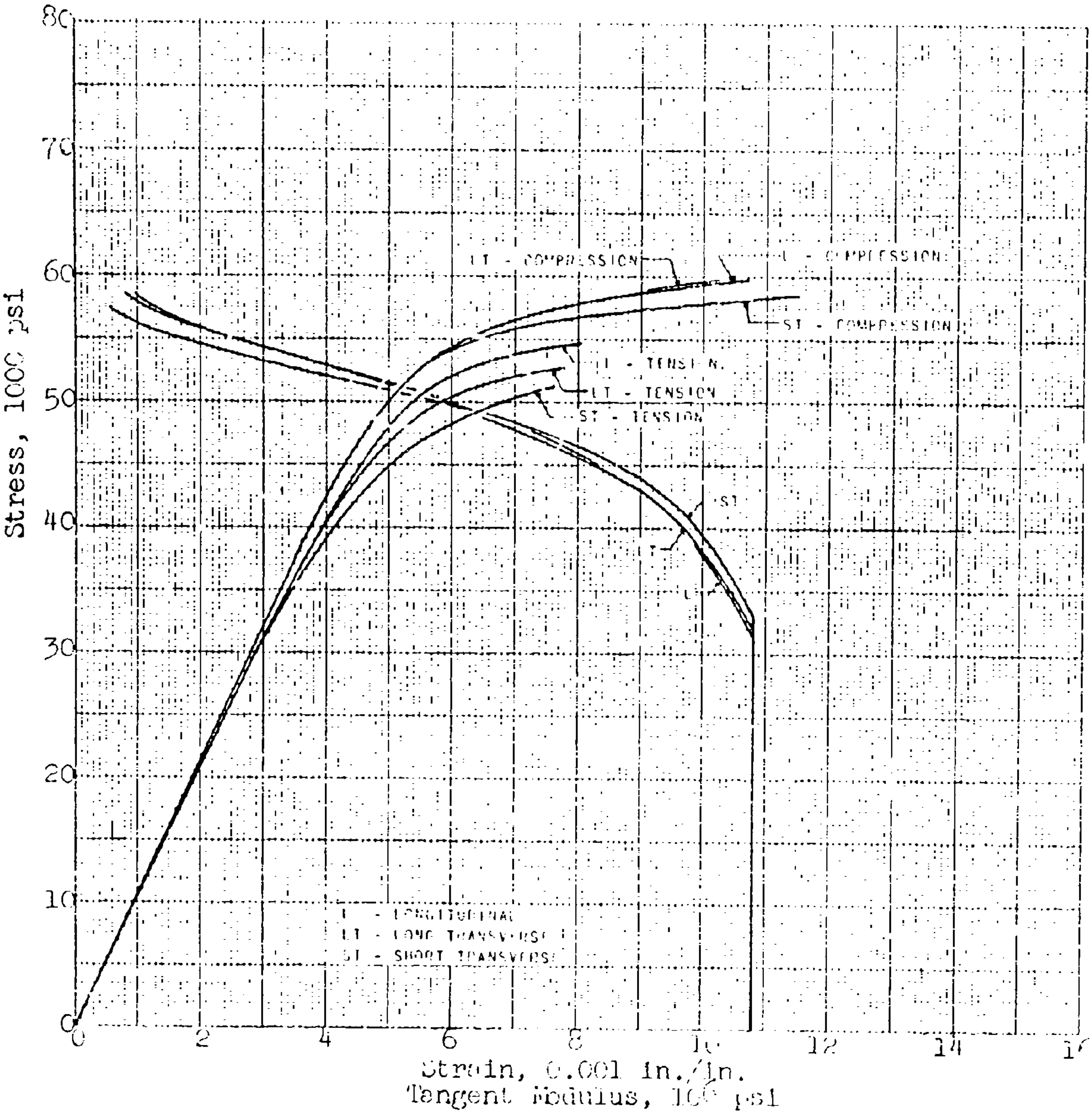



Fig. 14 Tentative Minimum Stress-Strain and Compressive Tangent-Modulus Curves for 2024-T852 Aluminum Alloy Hand Forgings, 2.001-3.000 in.

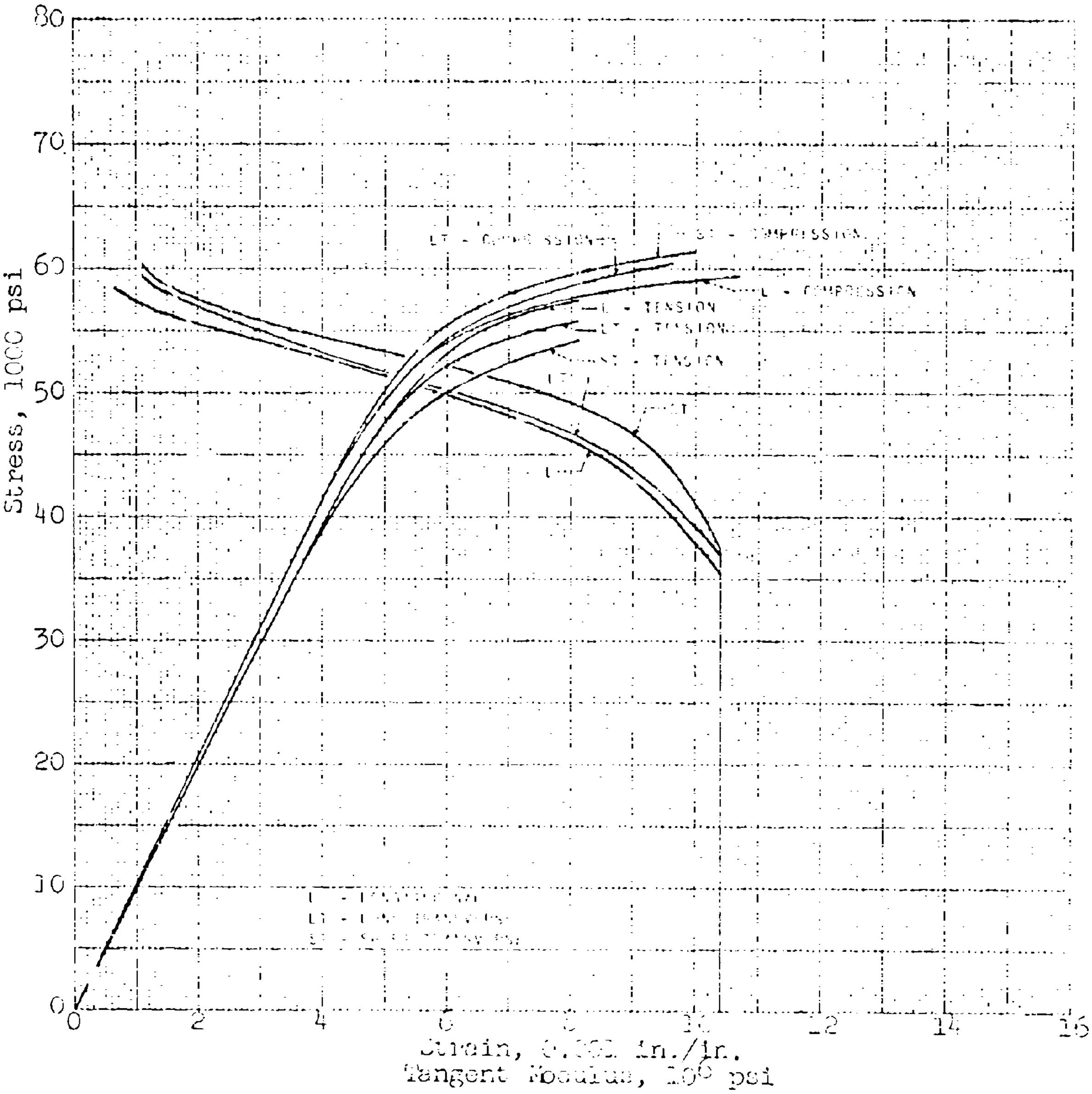



Fig. 15 Typical Stress-Strain and Compressive Tangent-Modulus Curves for 7075-T7352 Aluminum Alloy Hand Forgings, 3.001-5.000 in.

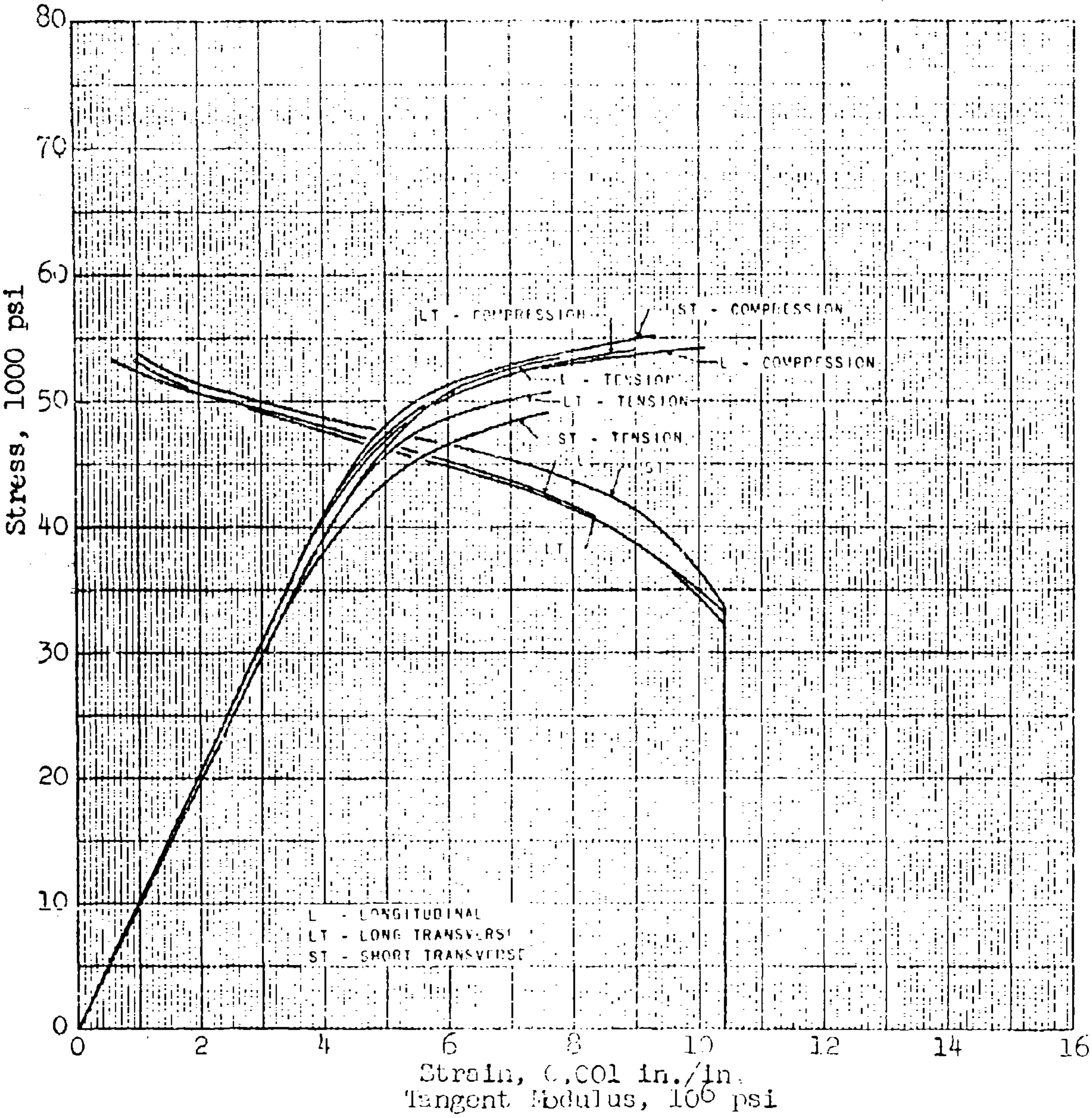



Fig. 16 Minimum ("S" Value) Stress-Strain and Compressive Tangent-Modulus Curves for 7075-T7352 Aluminum Alloy Hand Forgings, 3.001-4.000 in.

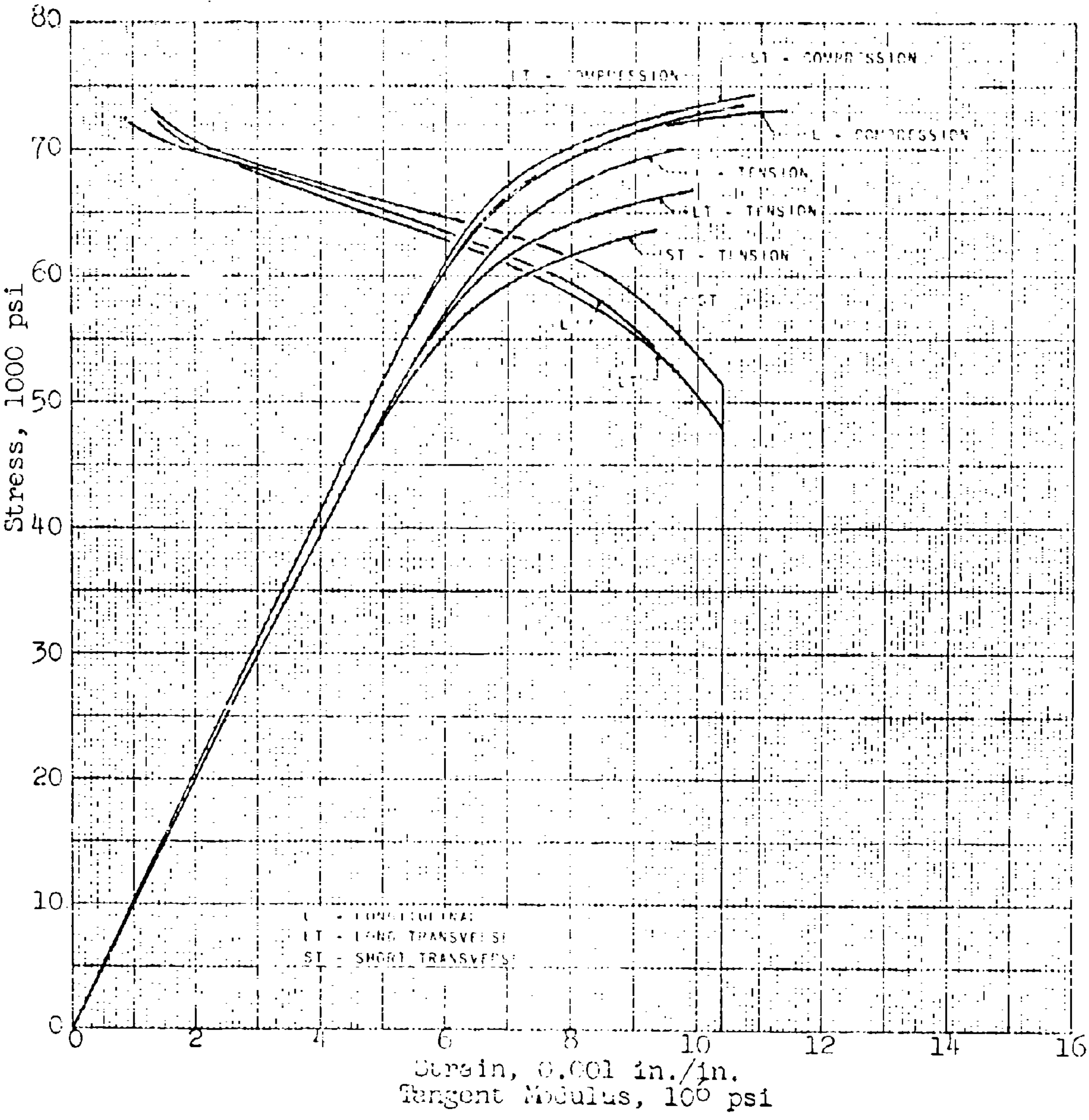



Fig. 17 Typical Stress-Strain and Compressive Tangent-Modulus Curves for 7079-T652 Aluminum Alloy Hand Forgings, 3.001-5.000 in.

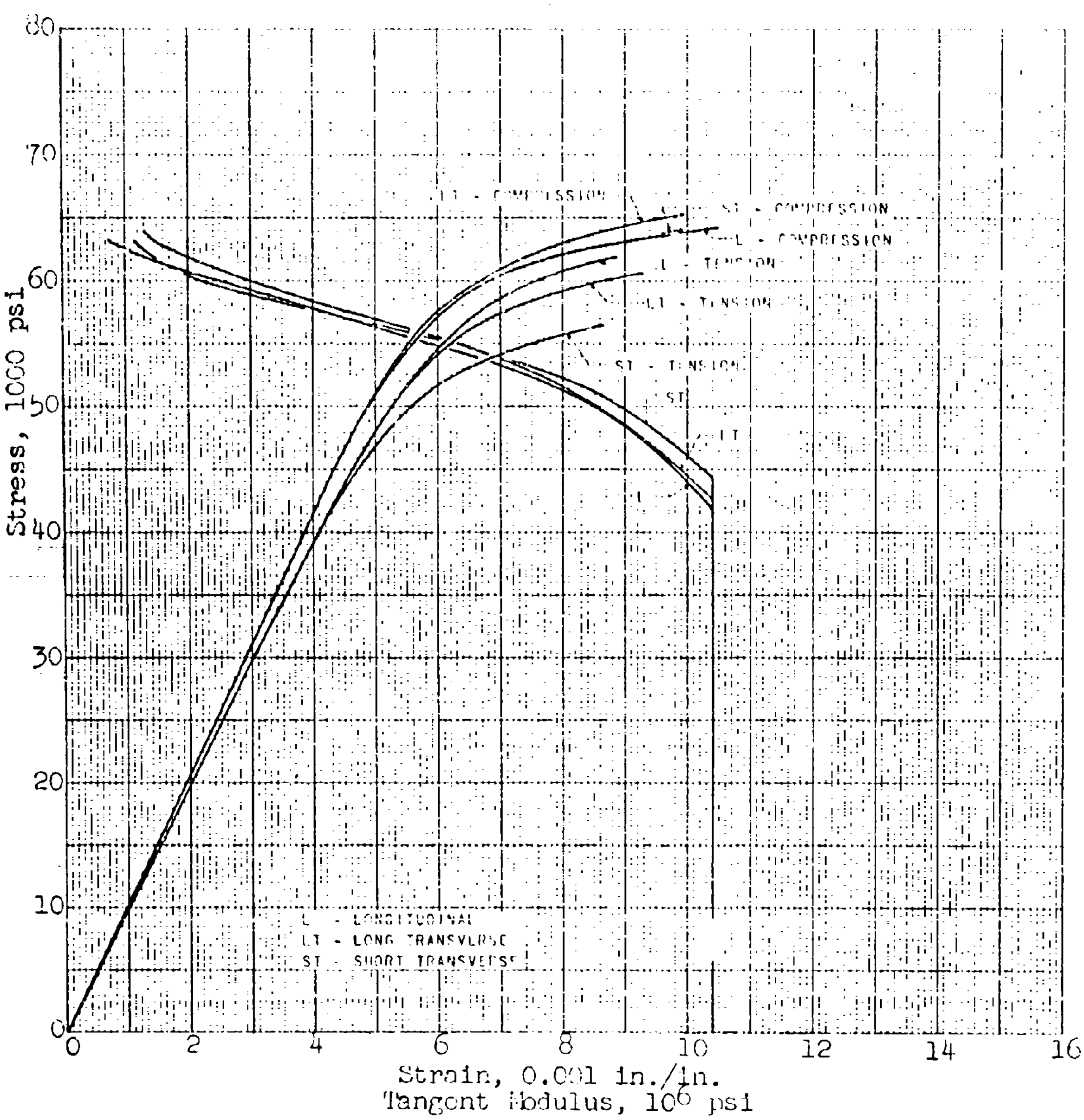



Fig. 18 Minimum ("S" Value) Stress-Strain and Compressive Tangent-Modulus Curves for 7079-T652 Aluminum Alloy Hand Forgings, 3.001-4.000 in.

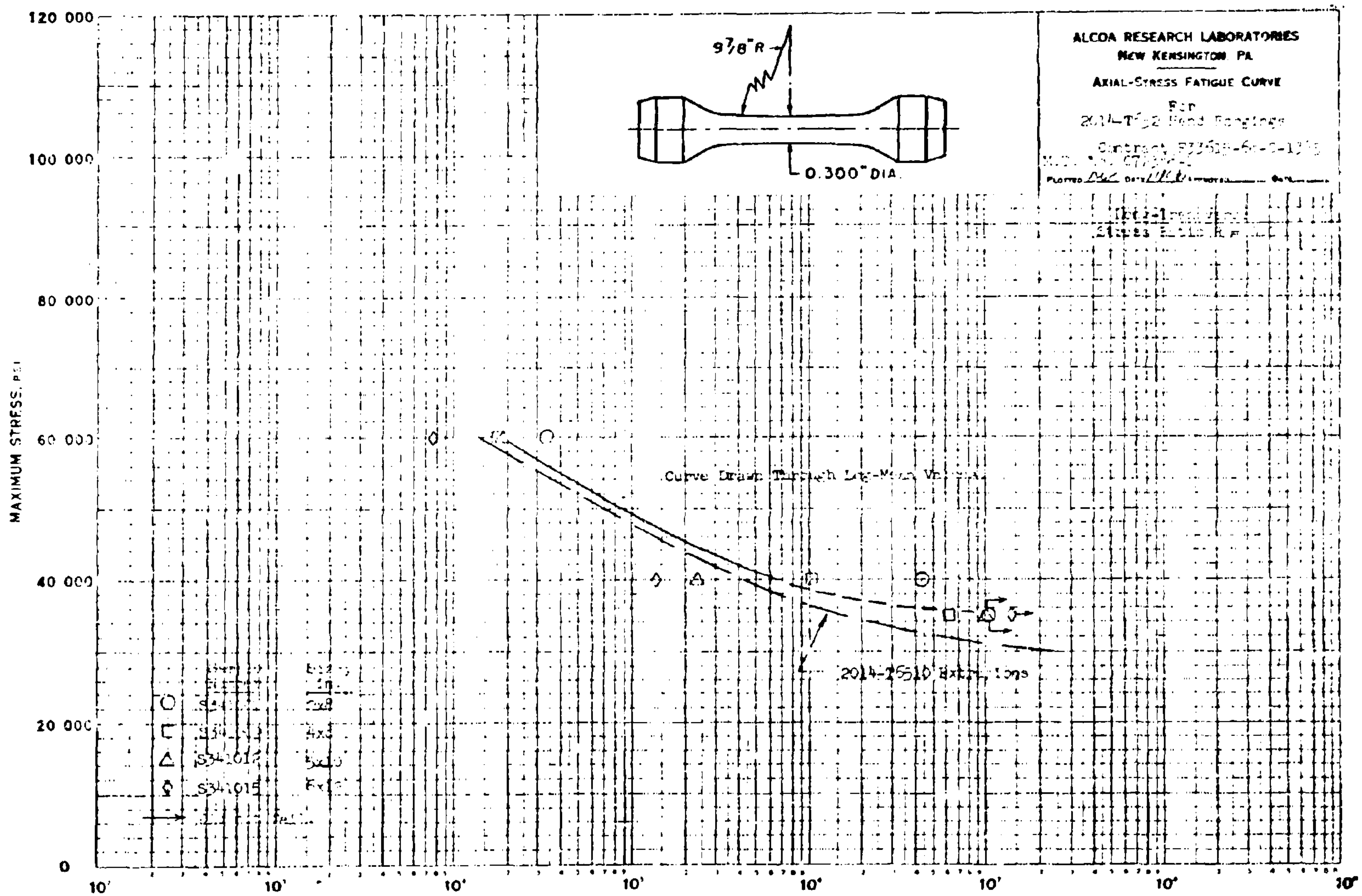

ALCOA RESEARCH LABORATORIES
NEW KENSINGTON, PA
AXIAL-STRESS FATIGUE CURVE
9 7/8" R
0.300" DIA
MAXIMUM STRESS, PSI
120 000
100 000
80 000
60 000
40 000
20 000
0
CYCLES
Curve Drawn Through Log-Mean Values
2014-T6510 Extrusions
S341012
S341015

Fig. 19

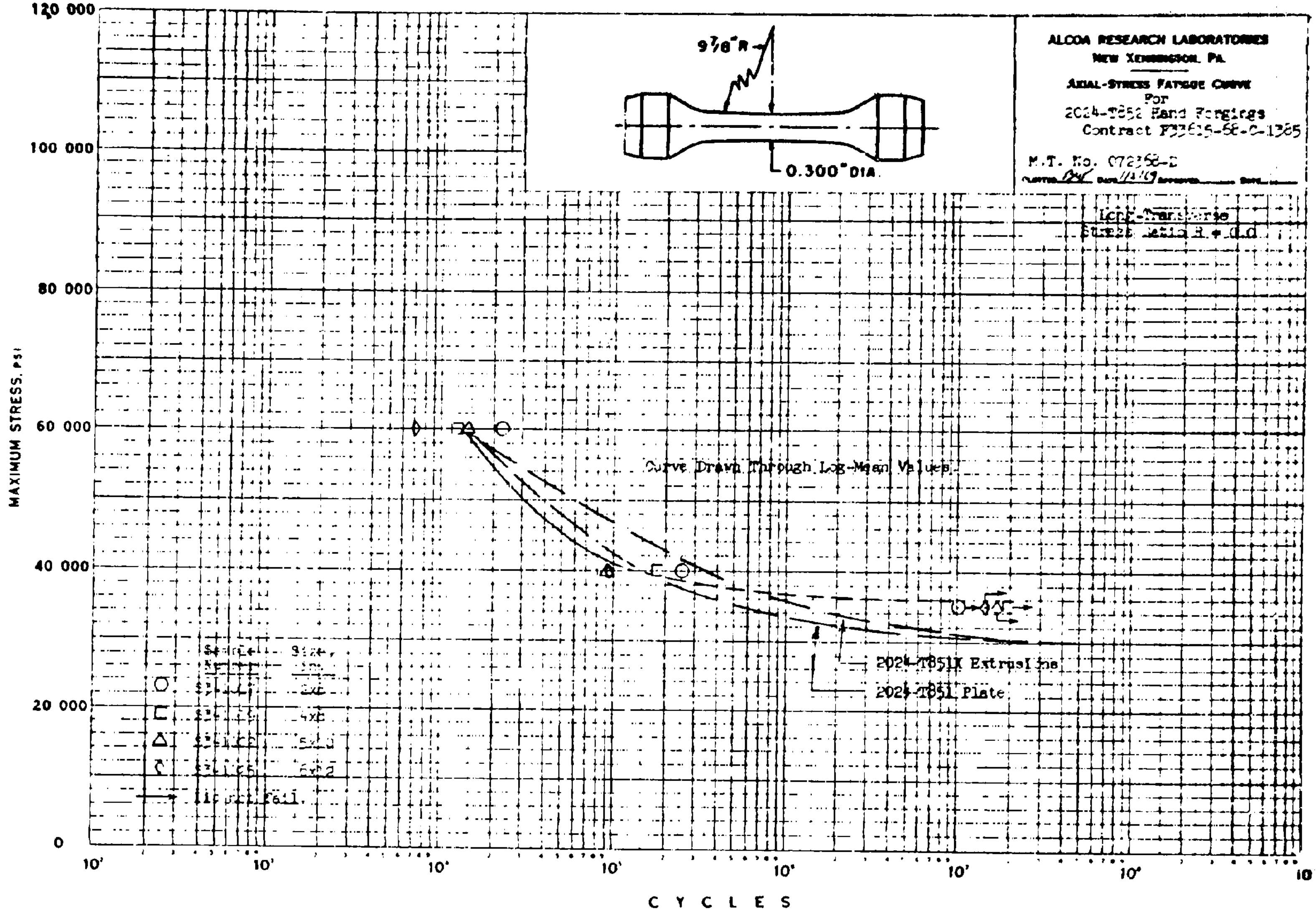

ALCOA RESEARCH LABORATORIES
New Kensington, Pa.
Axial-Stress Fatigue Curve
For
2024-T852 Hand Forgings
Contract F33615-68-C-1385
M.T. No. 072358-D
9 7/8" R
0.300" DIA.
Long-Transverse
Curve Drawn Through Log-Mean Values
2024-T851X Extrusions
2024-T851 Plate
MAXIMUM STRESS, PSI
120 000
100 000
80 000
60 000
40 000
20 000
0
CYCLES

Fig. 20

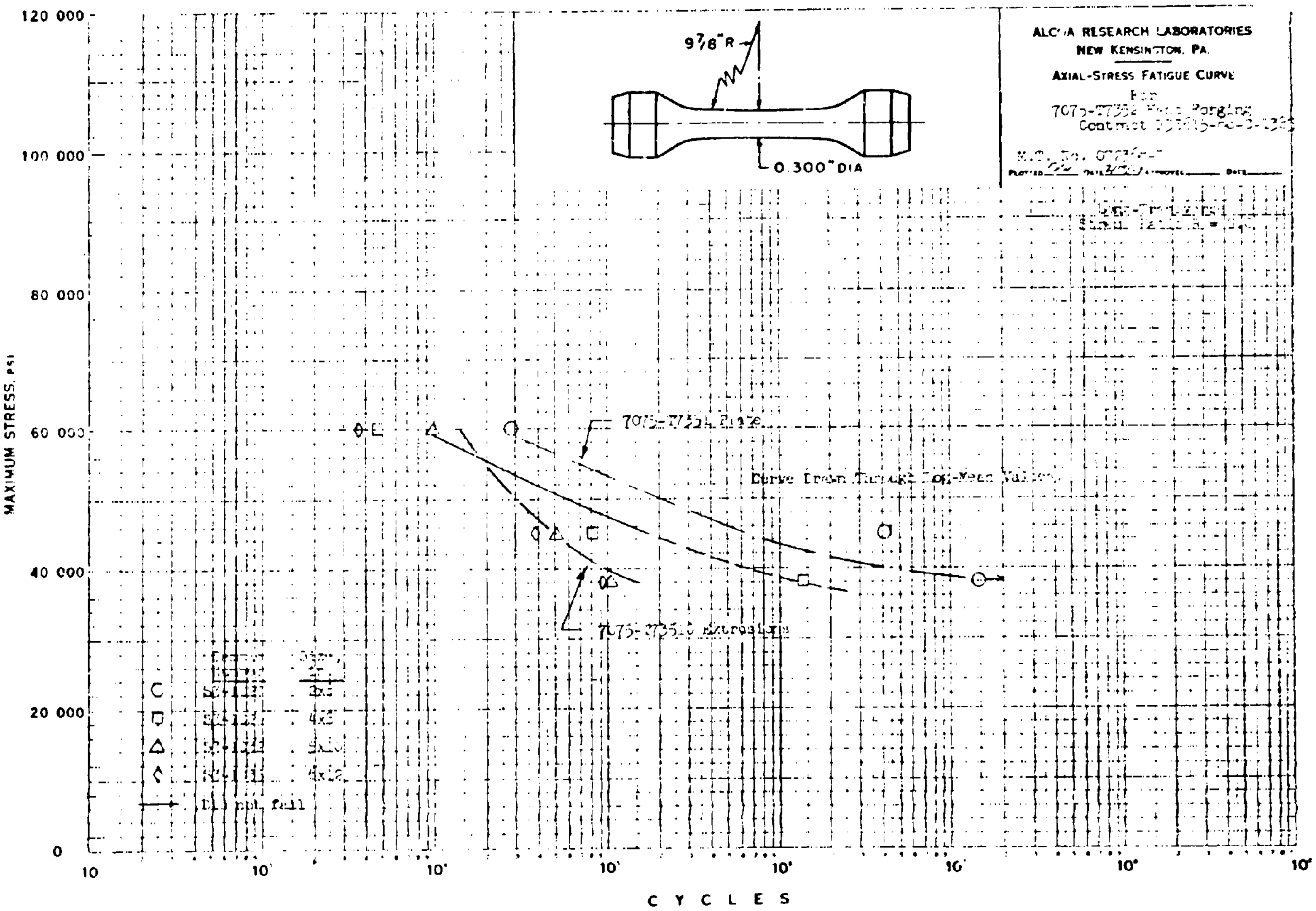

ALCOA RESEARCH LABORATORIES
NEW KENSINGTON, PA.
AXIAL-STRESS FATIGUE CURVE
0.300" DIA
MAXIMUM STRESS, PSI
120 000
100 000
80 000
60 000
40 000
20 000
0
CYCLES
Curve Drawn Through Log-Mean Values
Did not fail

Fig. 21

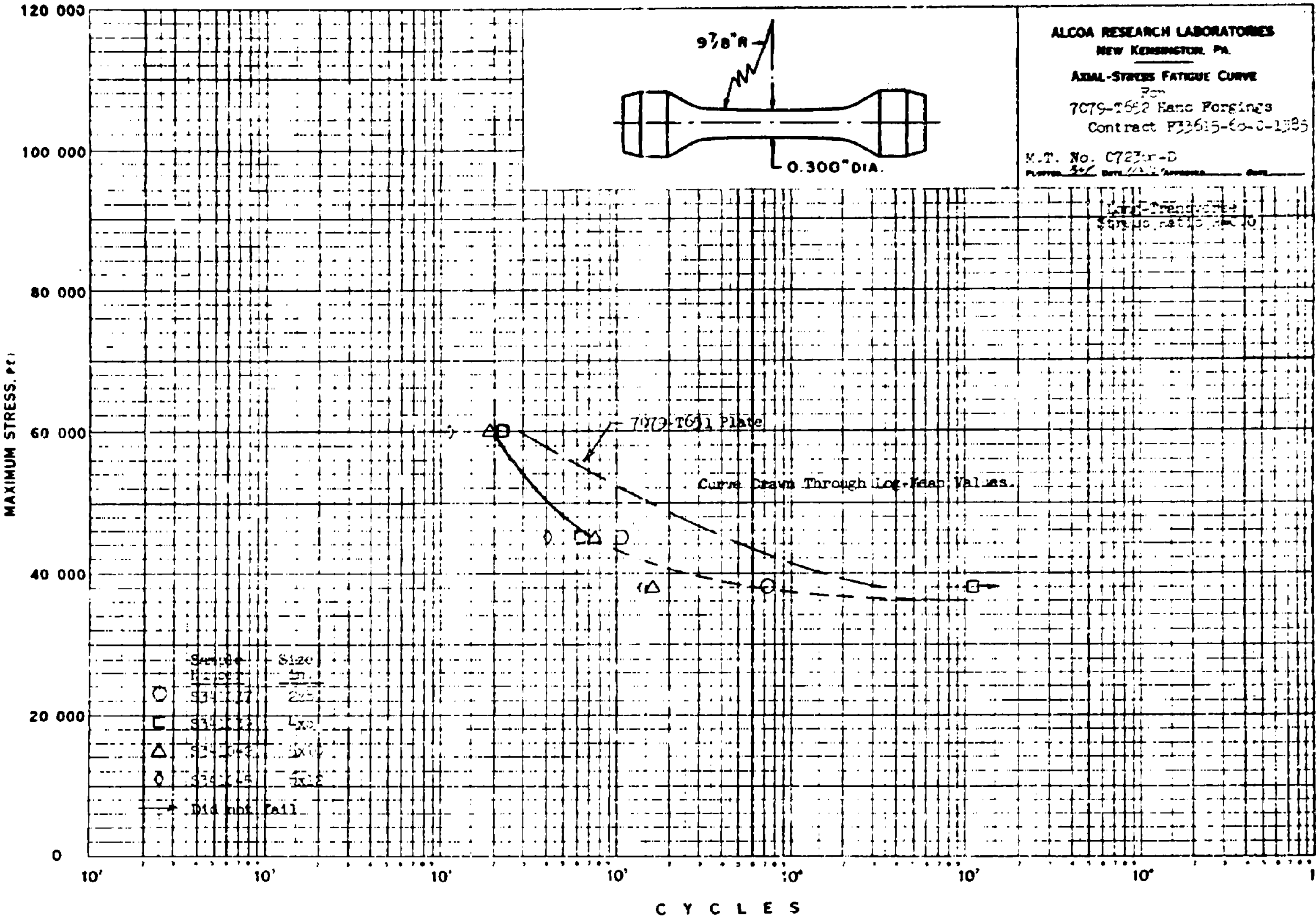

ALCOA RESEARCH LABORATORIES
NEW KENSINGTON, PA.
AXIAL-STRESS FATIGUE CURVE
7079-T652 Hand Forgings
Contract F33615-
9⅞"R
0.300" DIA.
7079-T651 Plate
Curve Drawn Through Log-Mean Values.
MAXIMUM STRESS, PSI
120 000
100 000
80 000
60 000
40 000
20 000
0
Size
Did not fail
CYCLES

Fig. 22

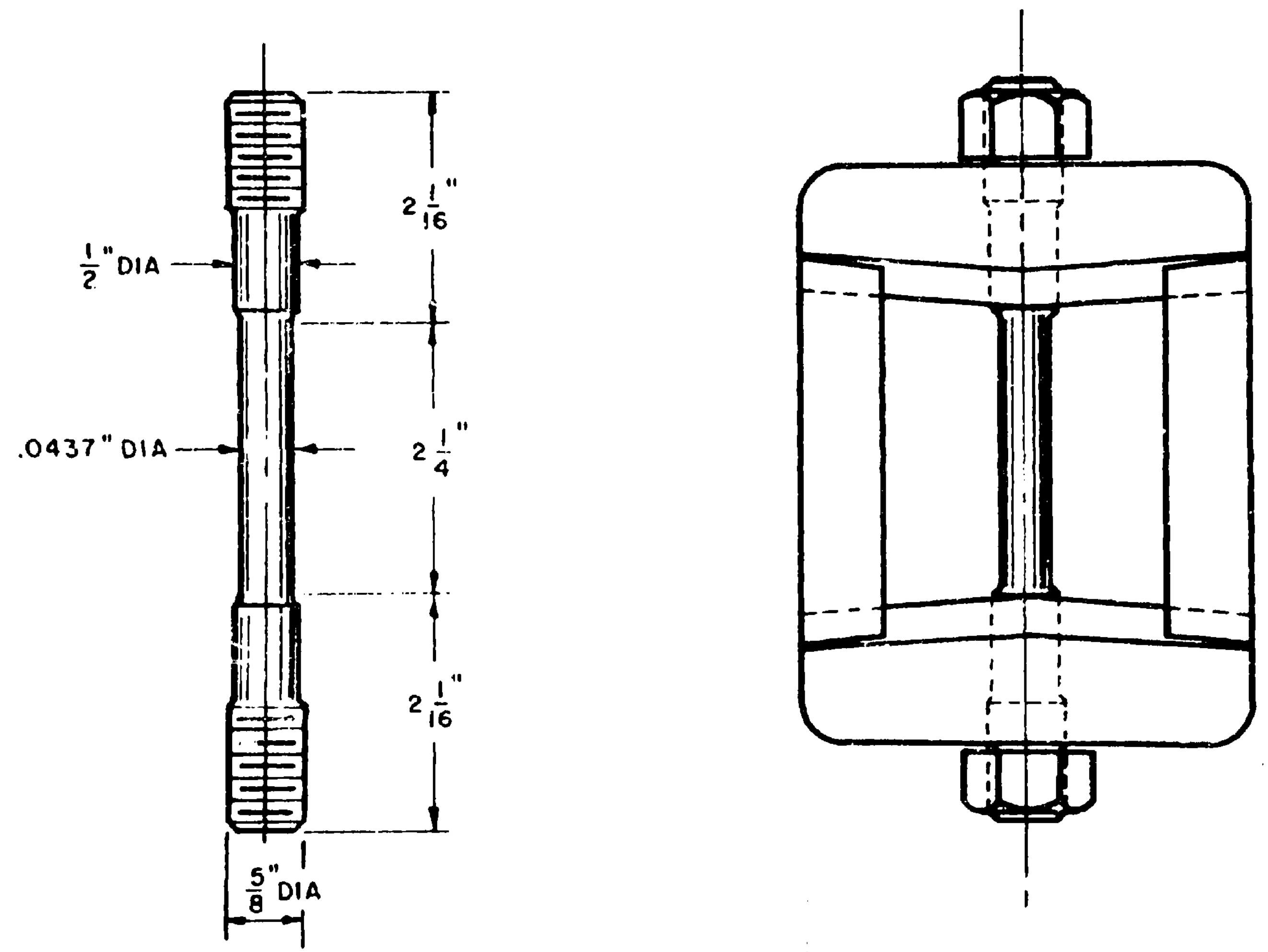



FIG. 23 0.437 IN. DIA. TENSILE SPECIMEN AND STRESSING FRAME

SIMULTANEOUS INWARD MOVEMENT OF THE WEDGE-SHAPED SIDE PIECES INDUCES UNIAXIAL TENSION STRESS IN THE SPECIMEN

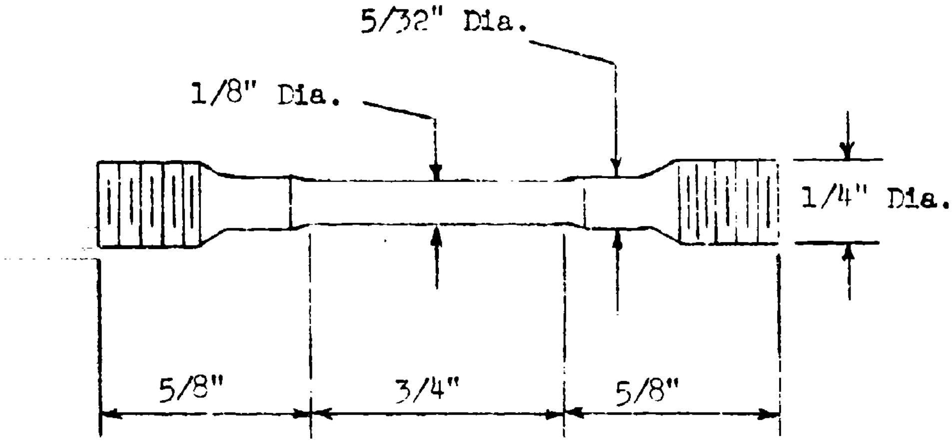
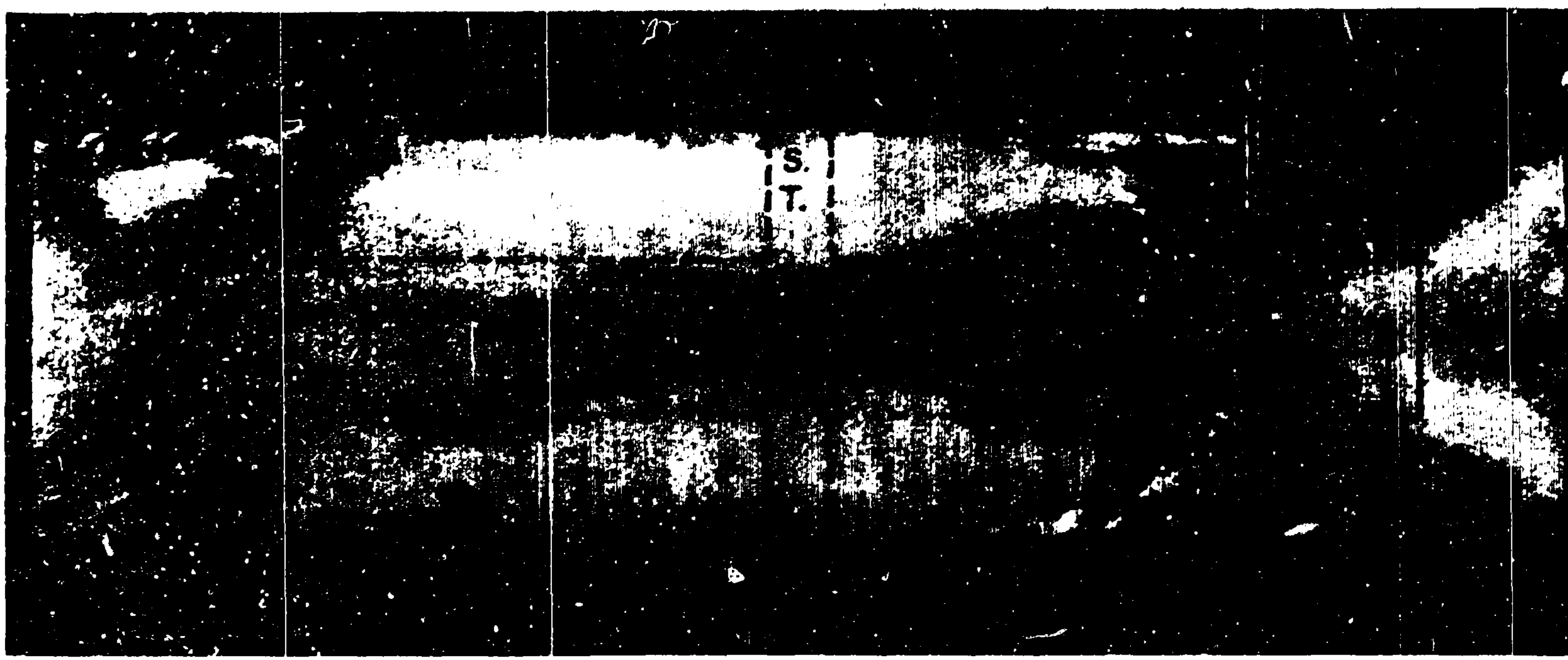
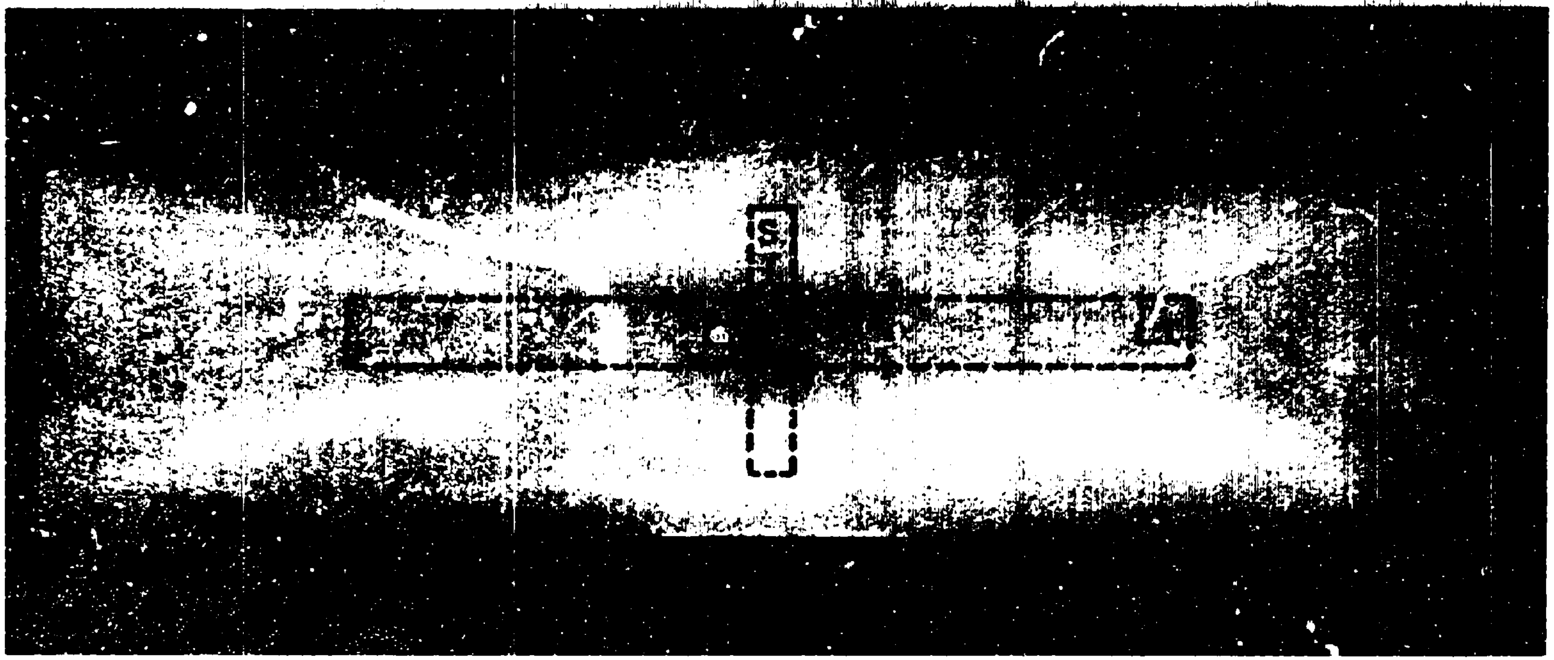



Fig. 24. 0.125-inch Diameter Tensile Specimen For Stress-Corrosion Tests.



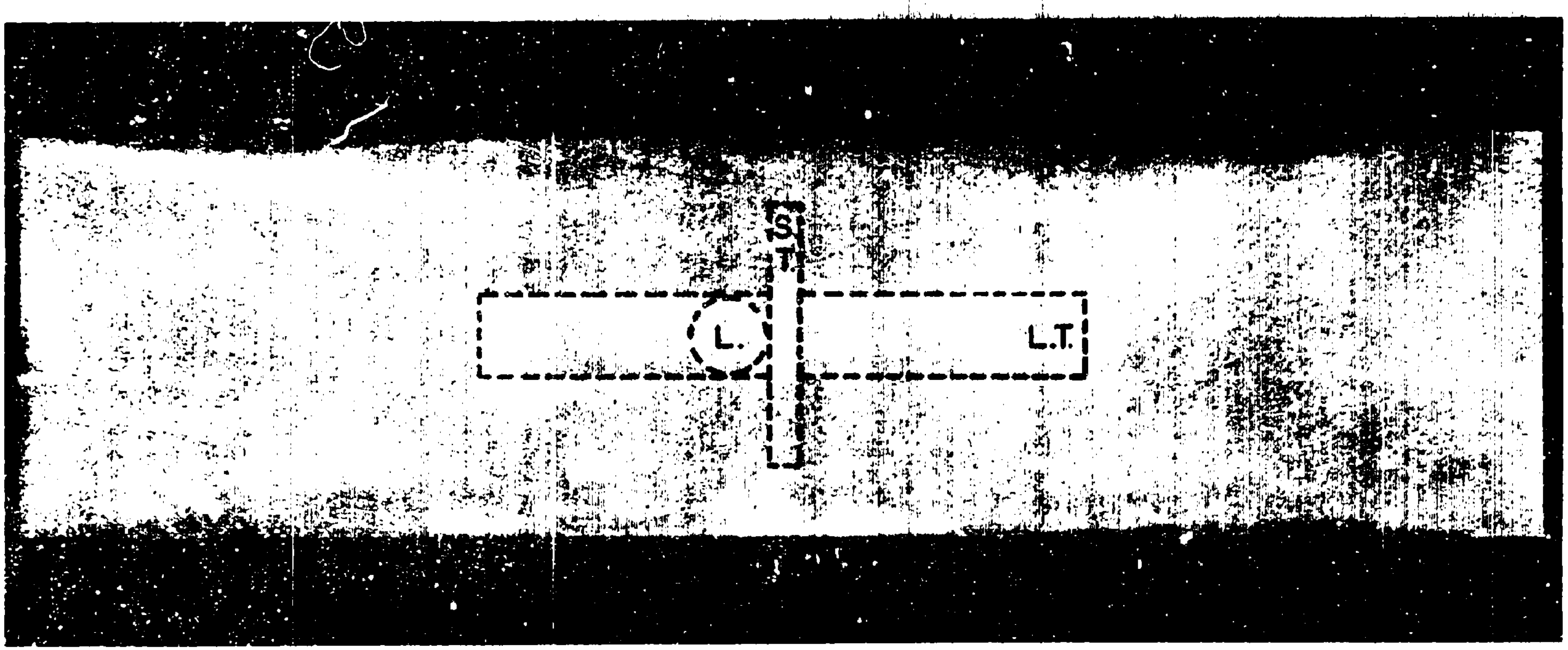

MAG: 1.2X

Figure 25 Macroetched transverse section of 2 x 8-in. hand forging of 2014-T652 alloy. Superimposed on the photograph is a schematic diagram of the location of stress-corrosion test specimens.



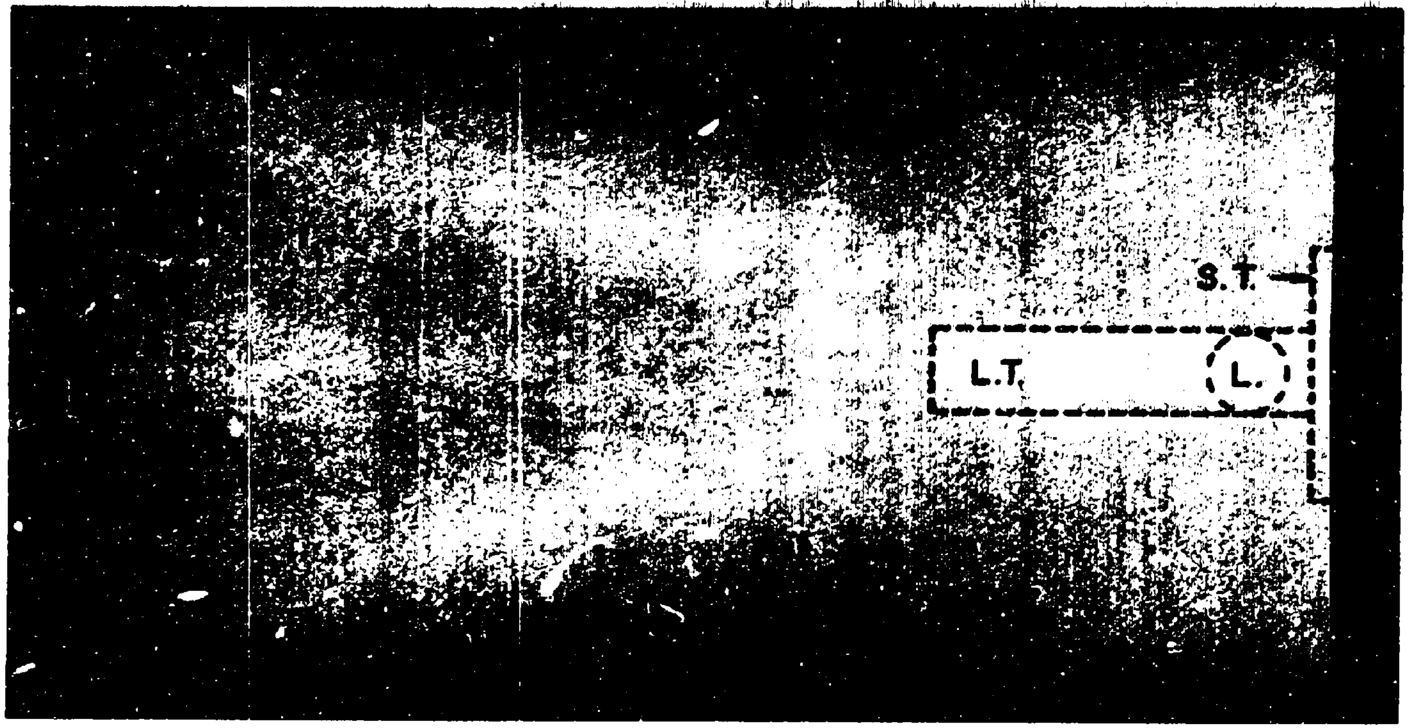

MAG: 0.8X

Figure 26 Macroetched transverse section of 3 x 12-in. hand forging of 2014-T652 alloy. Superimposed on the photograph is a schematic diagram of the location of stress-corrosion test specimens.



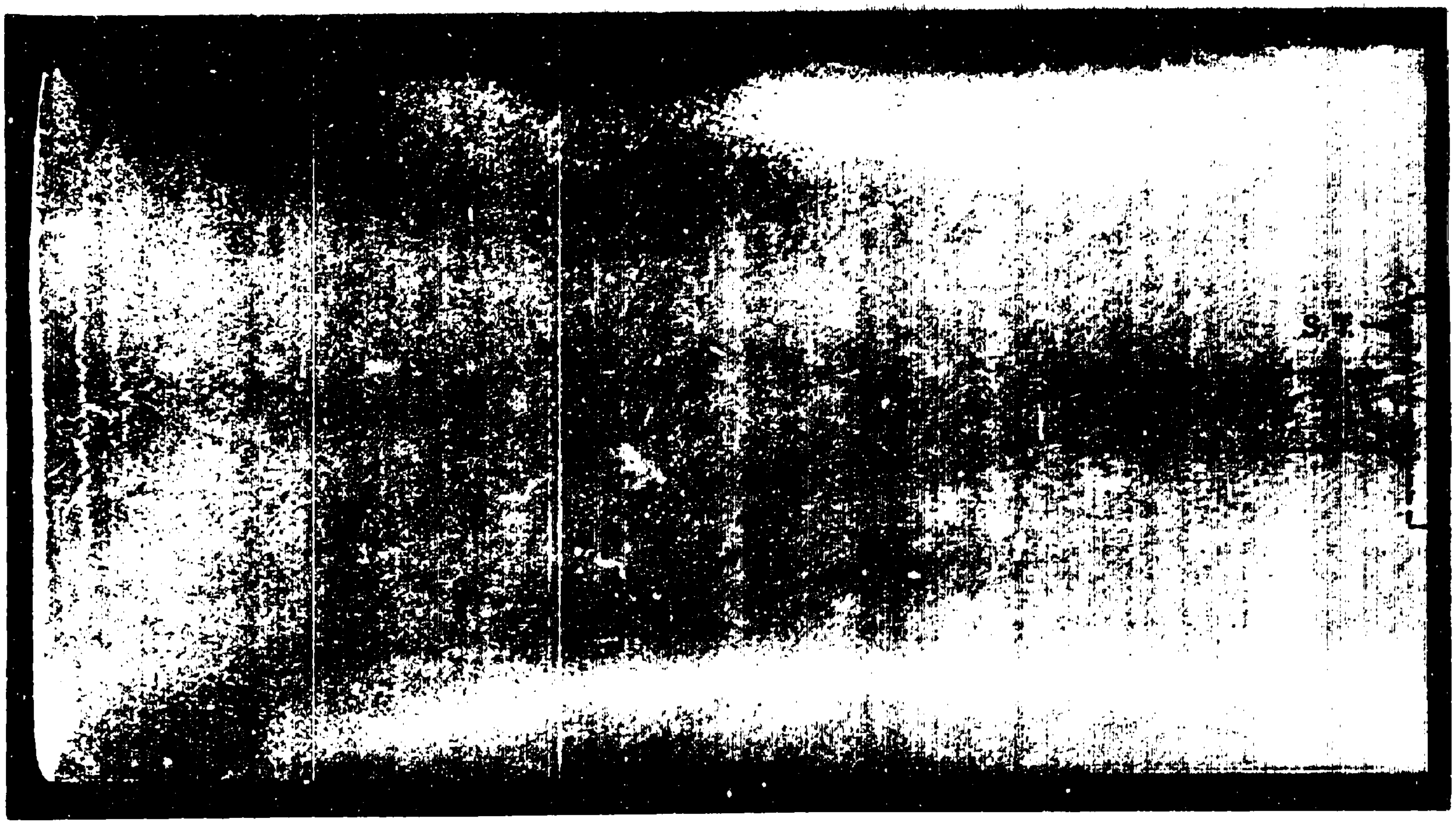

MAG: 0.6X

Figure 27 Macroetched transverse section of 4 x 16-in. hand forging of 2014-T652 alloy. Superimposed on the photograph is a schematic diagram of the location of stress-corrosion test specimens.



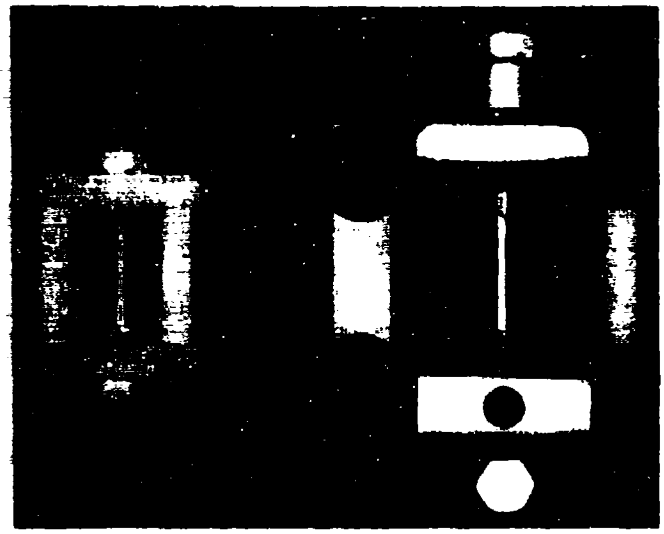

MAG: 0.75X

Figure 28 Macroetched half of transverse section of 5 x 20-in. hand forging of 2014-T652 alloy. Grain pattern in the other half of the transverse section was symmetrical to that shown above. Superimposed on the photograph is a schematic diagram of the location of stress-corrosion test specimens.



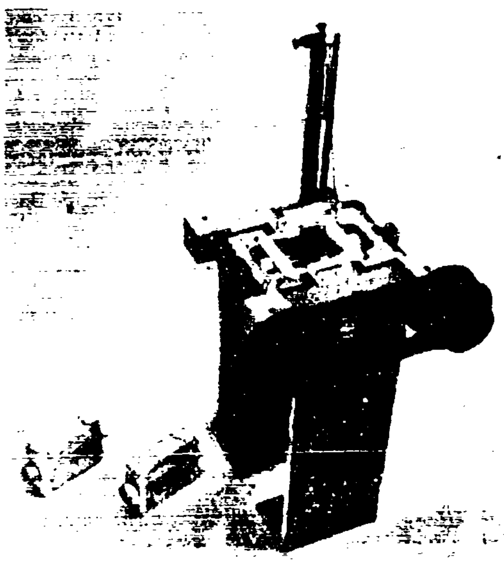
MAG. 0.75X

Figure 29 Macroetched half of transverse section of 6 x 24-in. hand forging of 2014-T652 alloy. Grain pattern in the other half of the transverse section was symmetrical to that shown above. Superimposed on the photograph is a schematic diagram of the location of stress-corrosion test specimens.



Mag: 1/2X

FIG. 30 SHOWS THE 1/8-IN. DIAMETER TENSILE SPECIMEN, THE VARIOUS PARTS OF THE STRESSING FRAME AND THE FINAL STRESSED ASSEMBLY.



Mag: 1/5X

FIG. 31 SYNCHRONOUS LOADING DEVICE USED TO STRESS SPECIMENS. A STRESSED ASSEMBLY AND ONE ASSEMBLED FINGER-TIGHT READY FOR STRESSING ARE SHOWN TO THE LEFT. BOTH THE STRESSING FRAME AND THE LOADING DEVICE WERE DEVELOPED BY THE ALCOA RESEARCH LABORATORIES, PRIOR TO THIS CONTRACT.

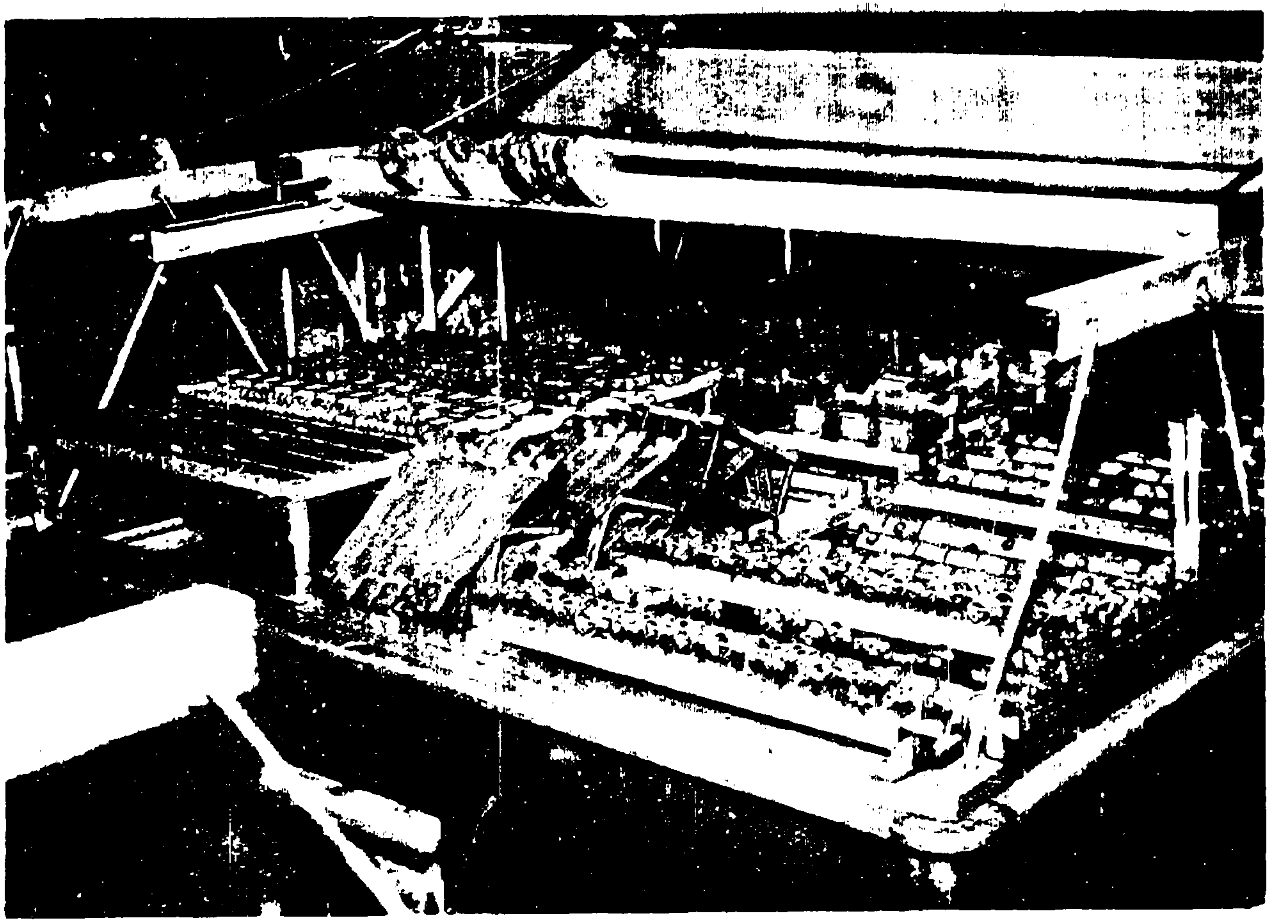
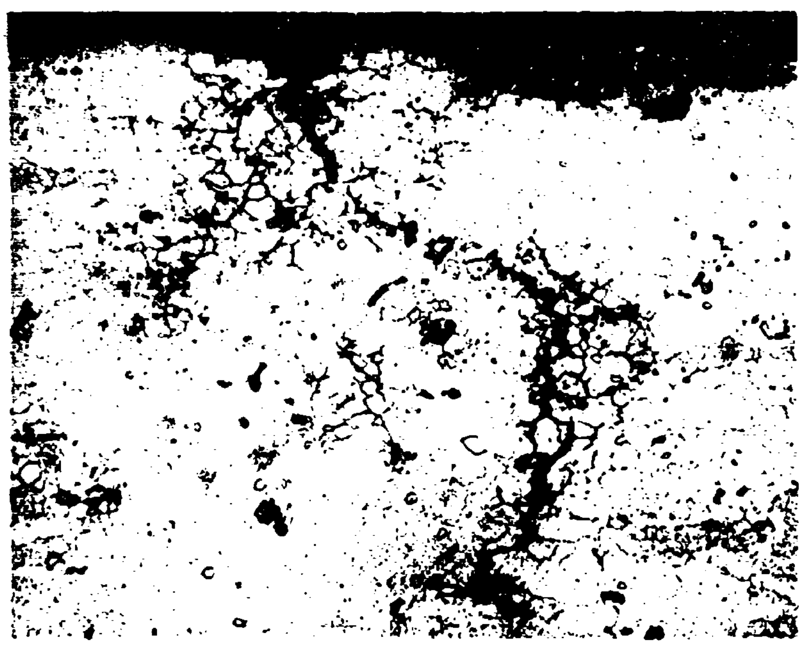


Fig. 32 Equipment for Alternate Immersion Corrosion Tests

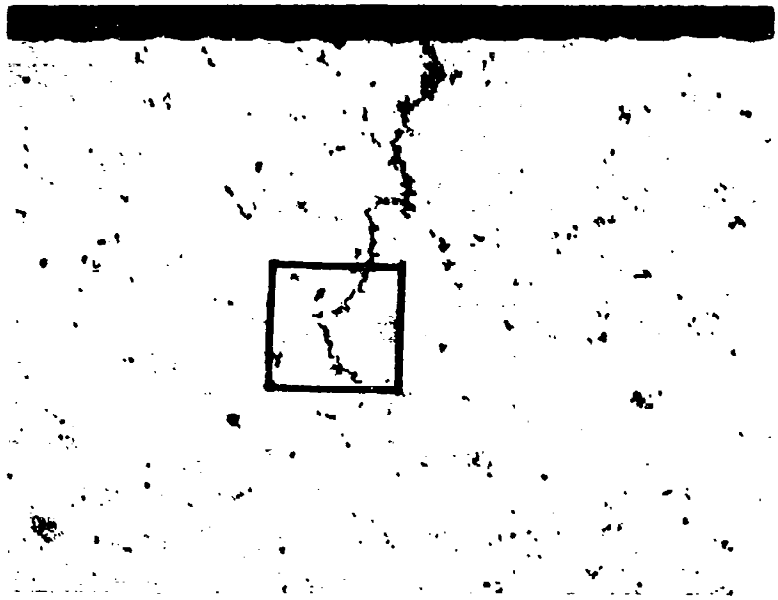
S.No. 341007-T4    Etch: Keller's    Mag. 100X

FIG. 33 Section Illustrating an Auxiliary Crack in Long-Transverse Specimen from 2-in. Thick 2014-T652 Forging which Failed at a Stress Equal to 75% Y.S.



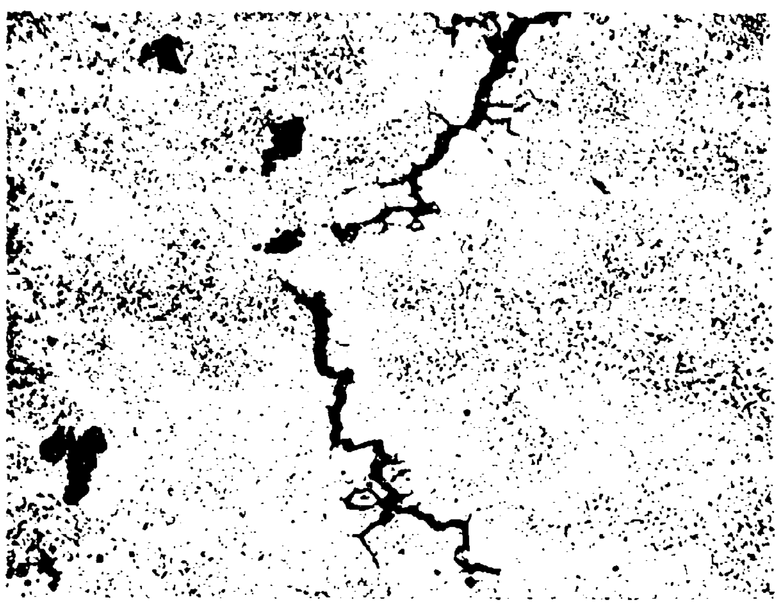
S.No. 341007-T4    Etch: Keller's    Mag. 500X

FIG. 34 Illustrates the Intergranular Character of the Crack Shown Above, Indicating that Failure was Result of Stress-Corrosion Cracking.



S. No. 341040-T4 Etch: Keller's Mag. 100X

Figure 35 Section illustrating an auxiliary crack in long-transverse specimen from 4 in. thick 7079-T652 forging which failed at a stress equal to 75% Y.S.

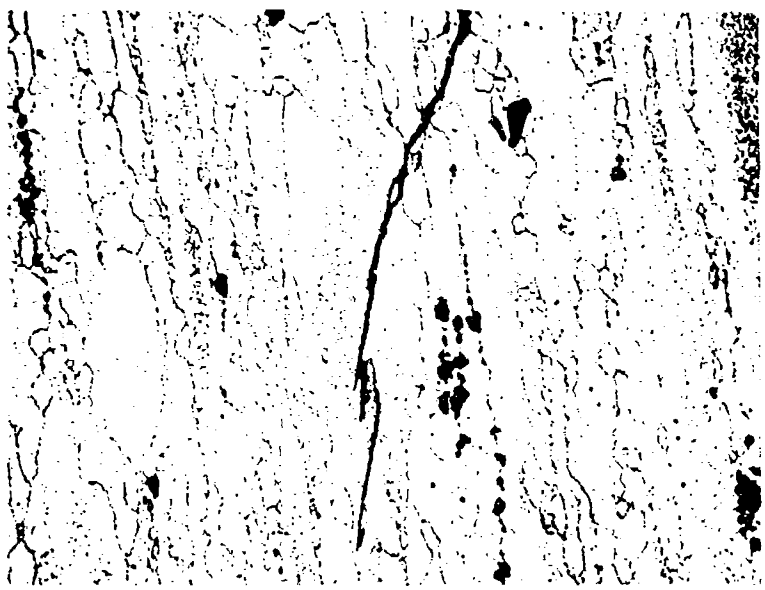


S. No. 341040-T4 Etch: Keller's Mag. 500X

Figure 36 Illustrates the intergranular character of the crack shown above, indicating that failure was result of stress-corrosion cracking.

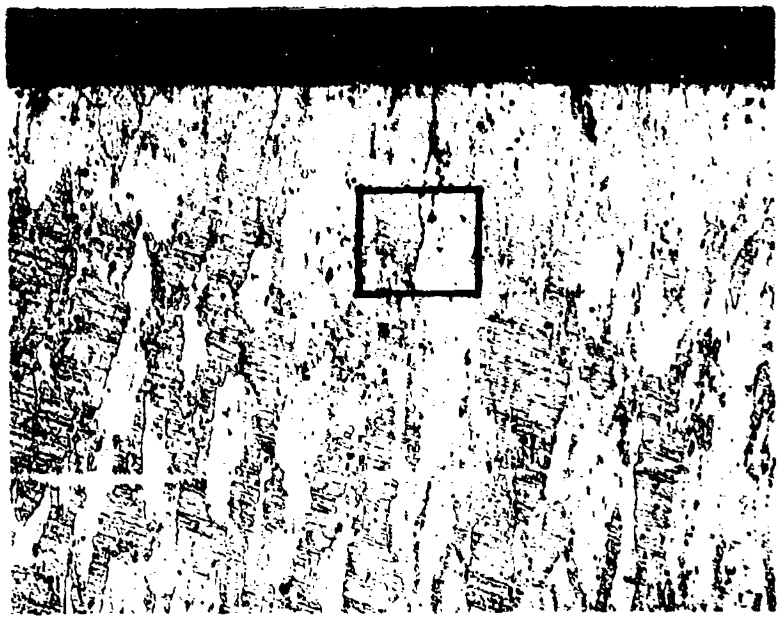
S. No. 341030-N3 Etch: Keller's Mag. 100X

Figure 37 Section illustrating fine crack emanating from the base of a corrosion pit in specimens from 4 in. thick 7075-T7352 forging which failed at a stress equal to 75% Y.S.



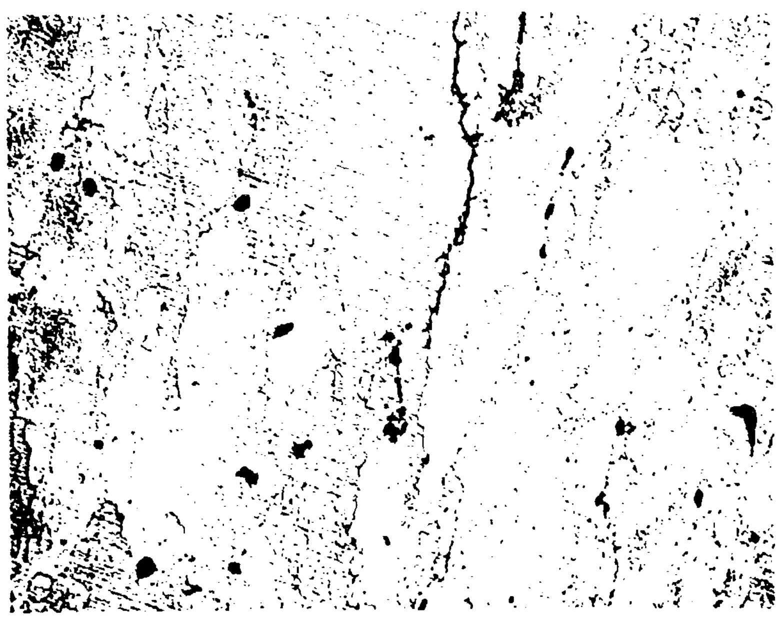
S. No. 341030-N3 Etch: Keller's Mag. 500X

Figure 38 Illustrates the transgranular character of the crack shown above, indicating that fracture was due to tensile overload resulting from severe localized corrosion.



S.No. 341028-N3 Etch: Keller's Mag. 100X

FIG. 39 Section Illustrating Fine Auxiliary Crack in Specimen from 3-in. Thick 7075-T7352 Forging Which Failed at a Stress Equal to 75% Y.S.



S.No. 341028-N3 Etch: Keller's Mag. 500X

FIG. 40 Illustrate the Intergranular Character of the Crack Shown Above, Indicating That Failure Was the Result of Stress-Corrosion Cracking.

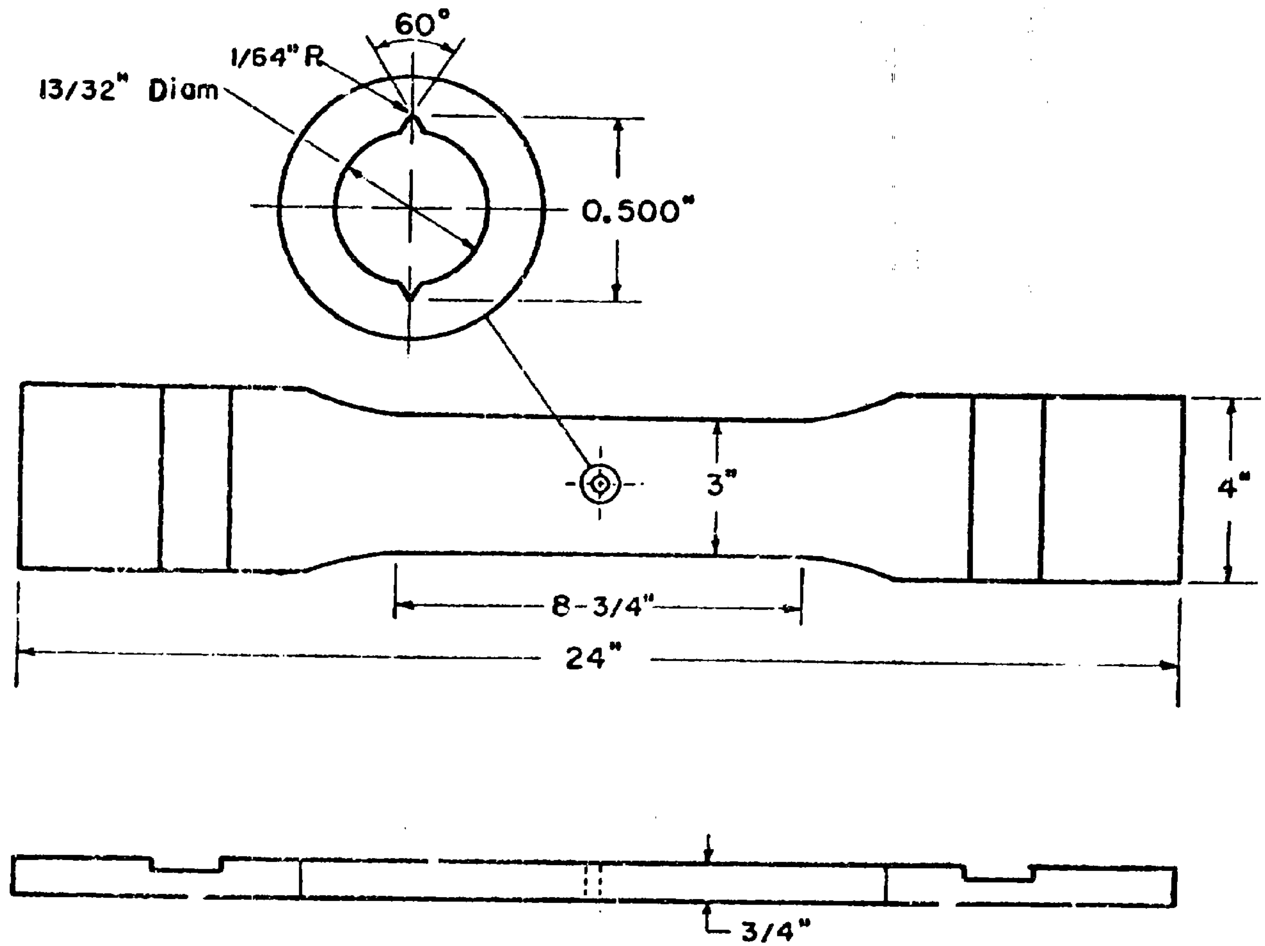



FIG. 41 CENTER-NOTCHED FATIGUE SPECIMENS
(MILD NOTCH)

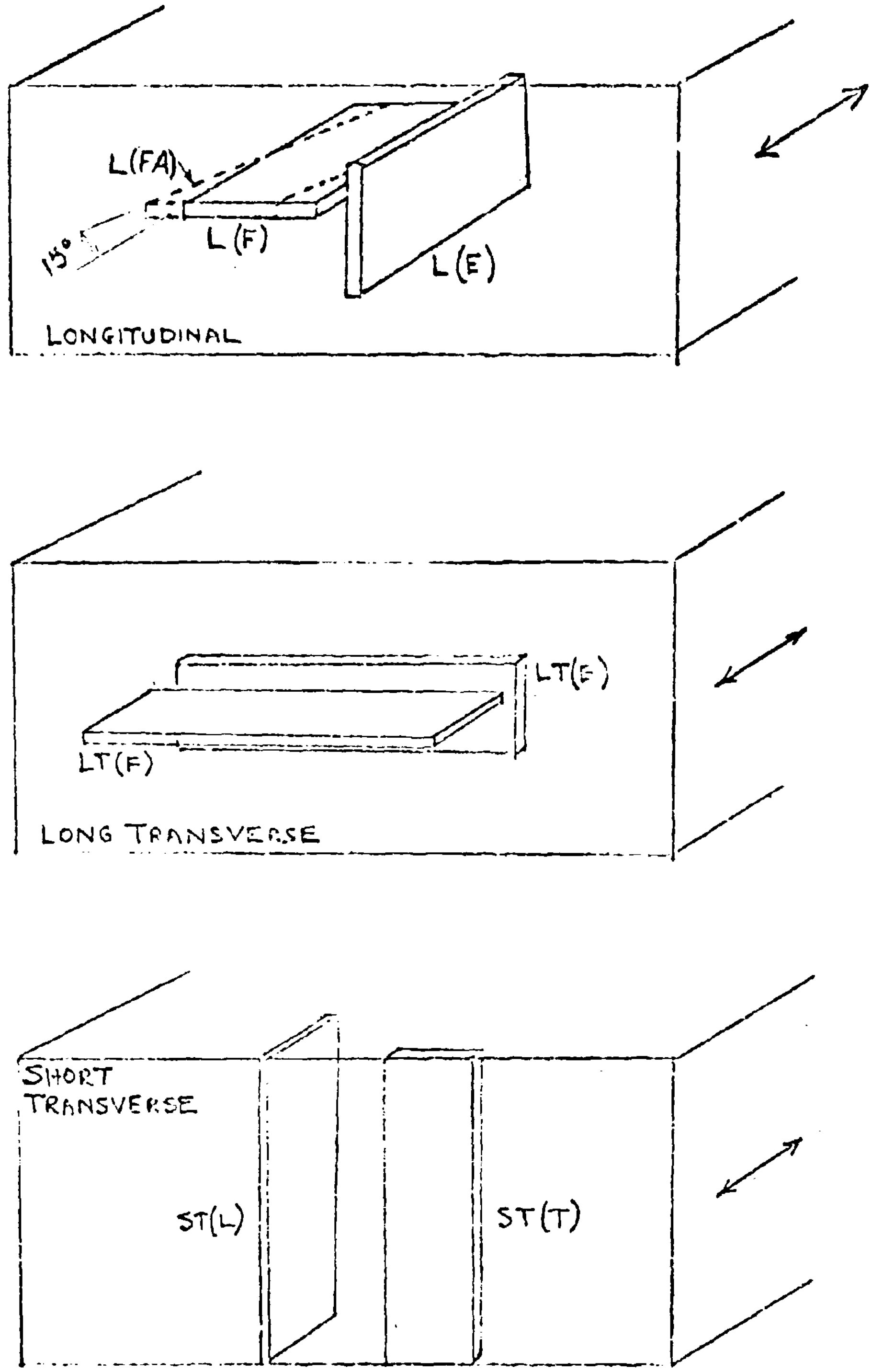



Fig. 42 Orientations of Fatigue-Crack Propagation Specimens.

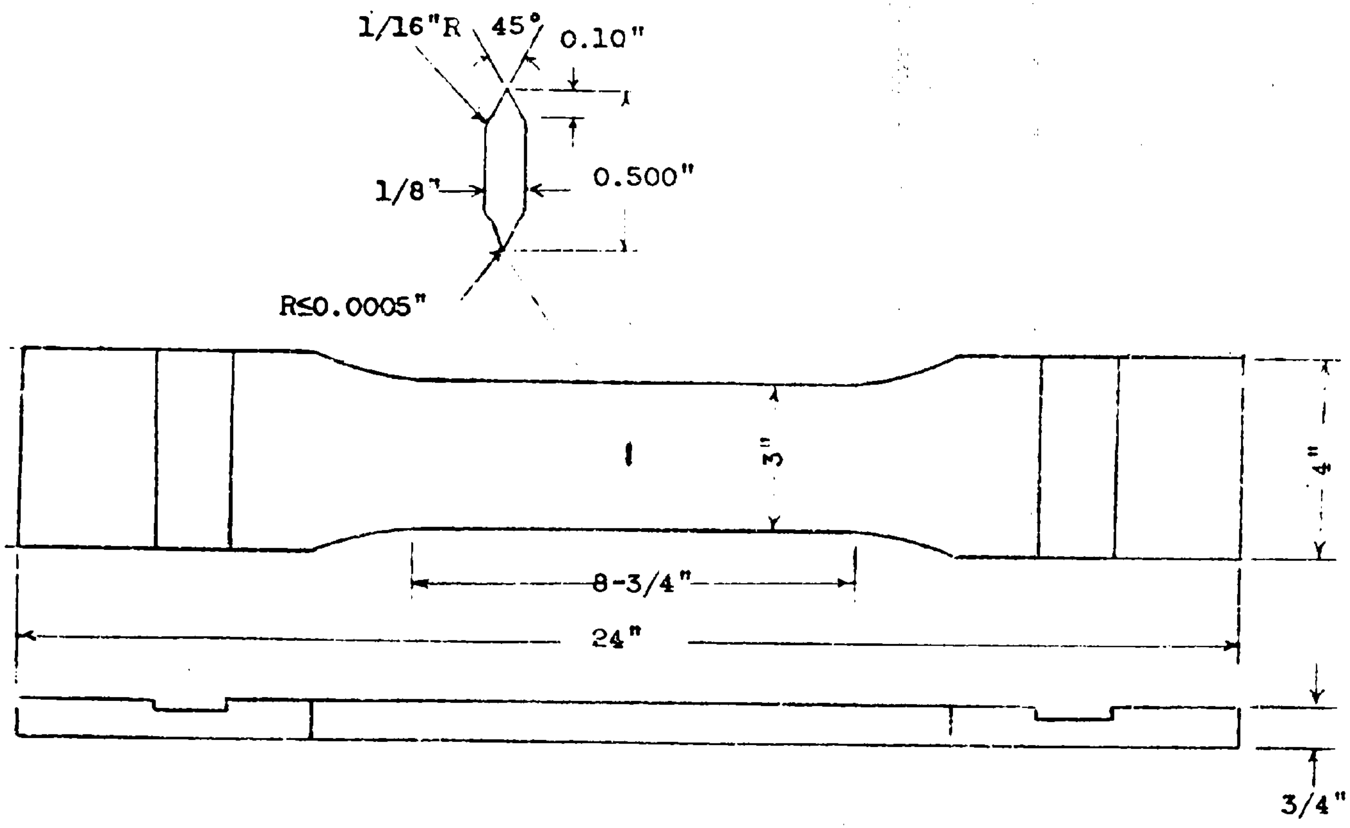
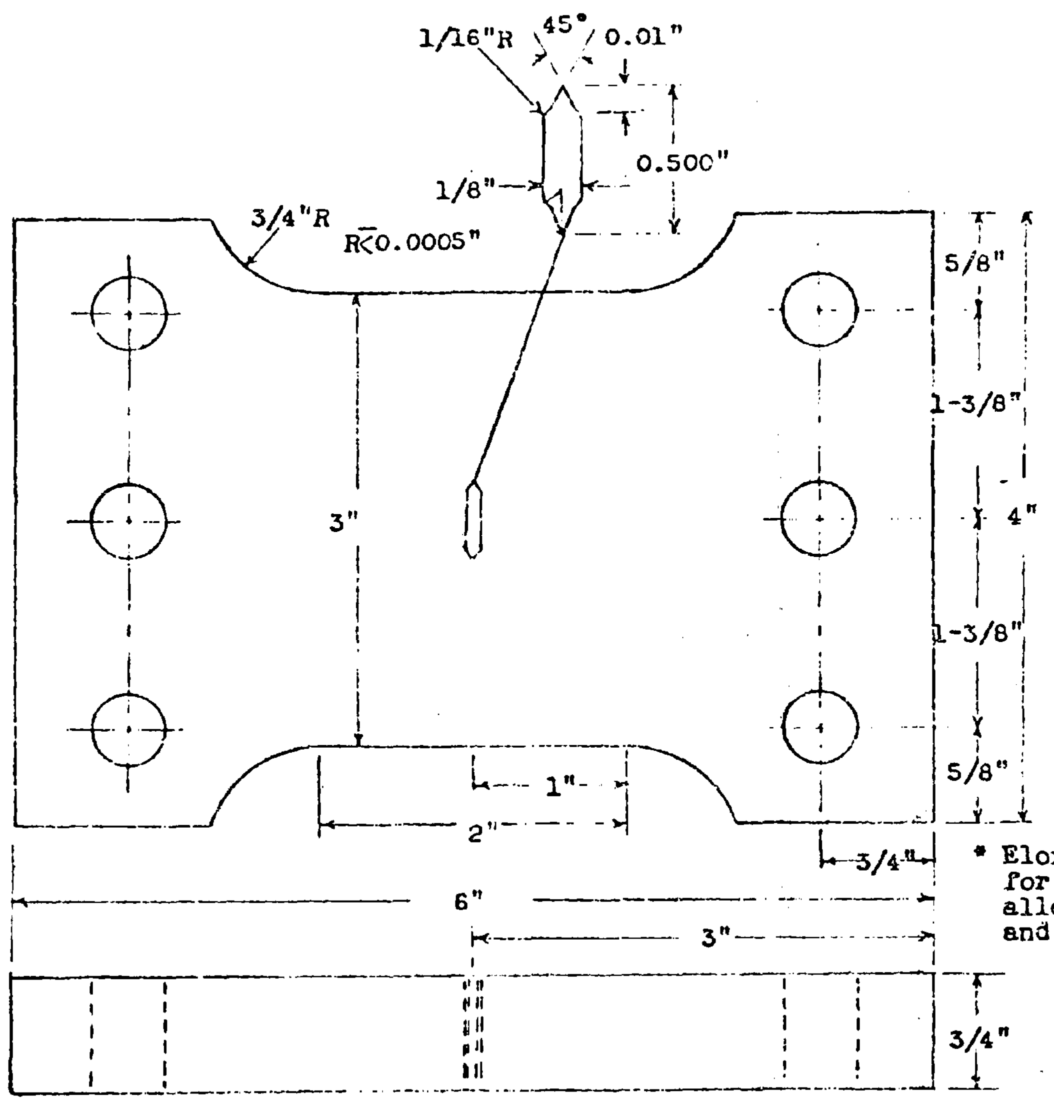
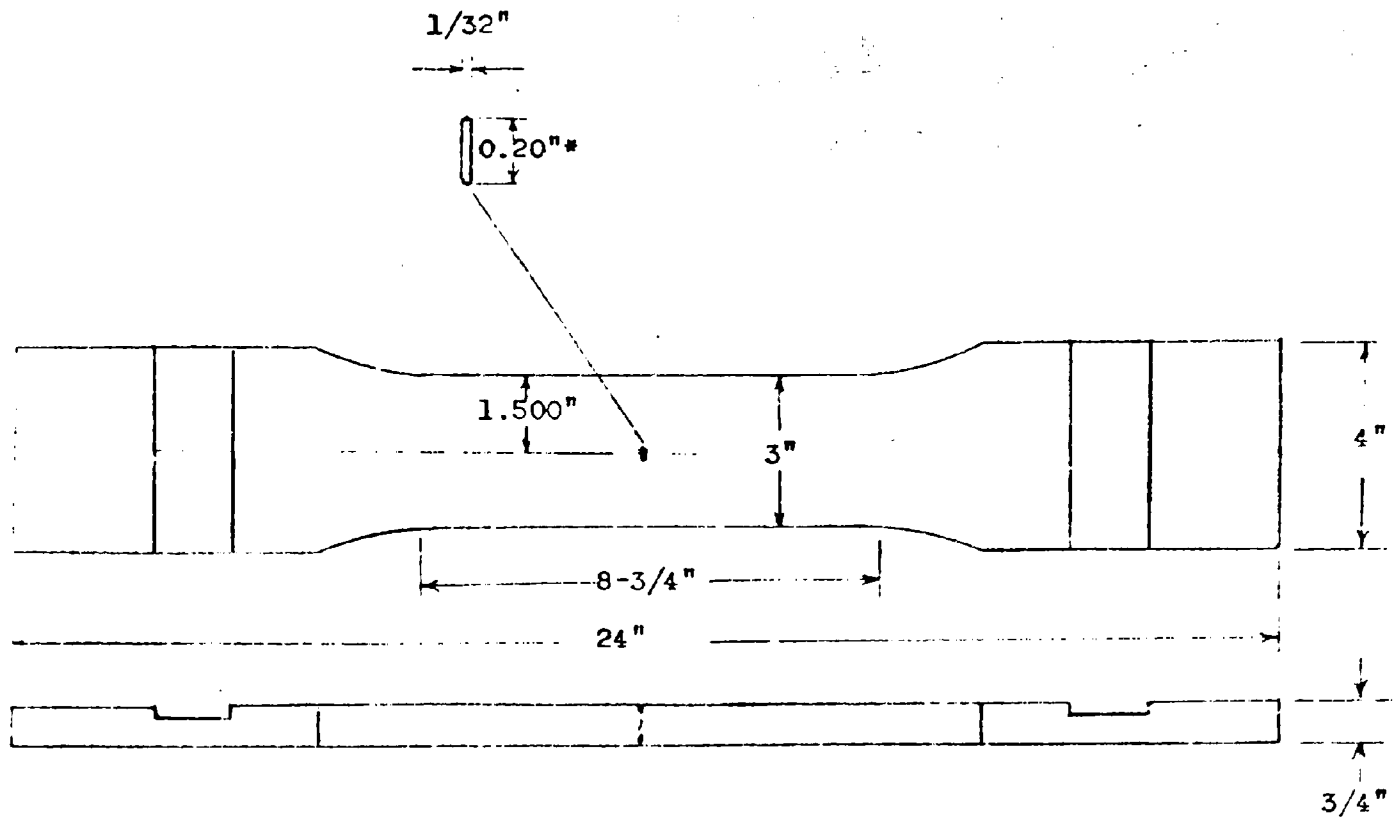



Fig. 43 Center-Notched Fatigue Specimen
(SHARP NOTCH)




* Elox notch used for specimens of alloys 7075-T7352 and 7079-T652.

Fig. 44 Short-Transverse Center-Notched Fatigue Specimen*




*Specimen precracked to 0.50 in.

Fig. 45 Elox Notched Crack Propagation Specimen

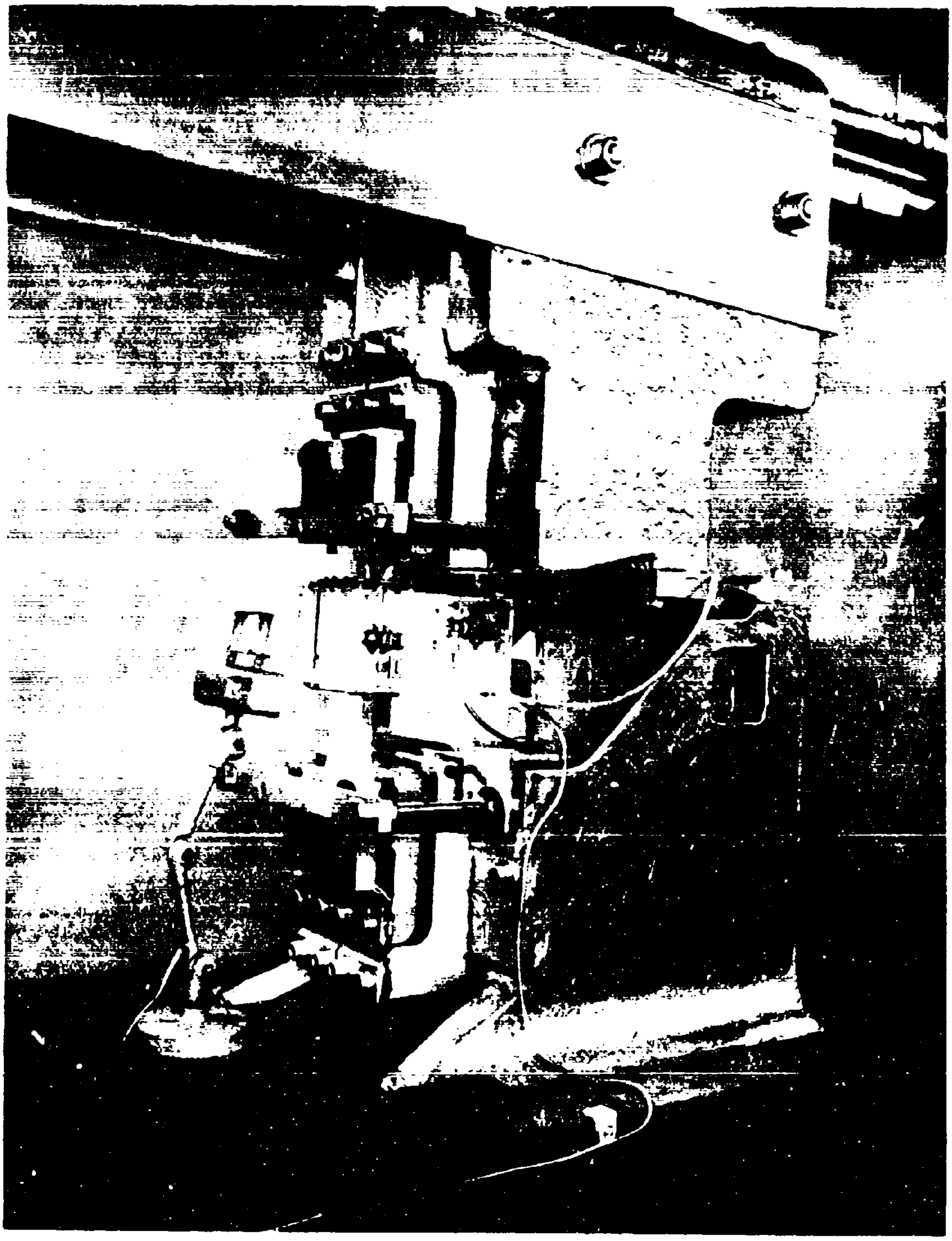


Fig. 46 Crack Propagation Specimen in Environmental Chamber

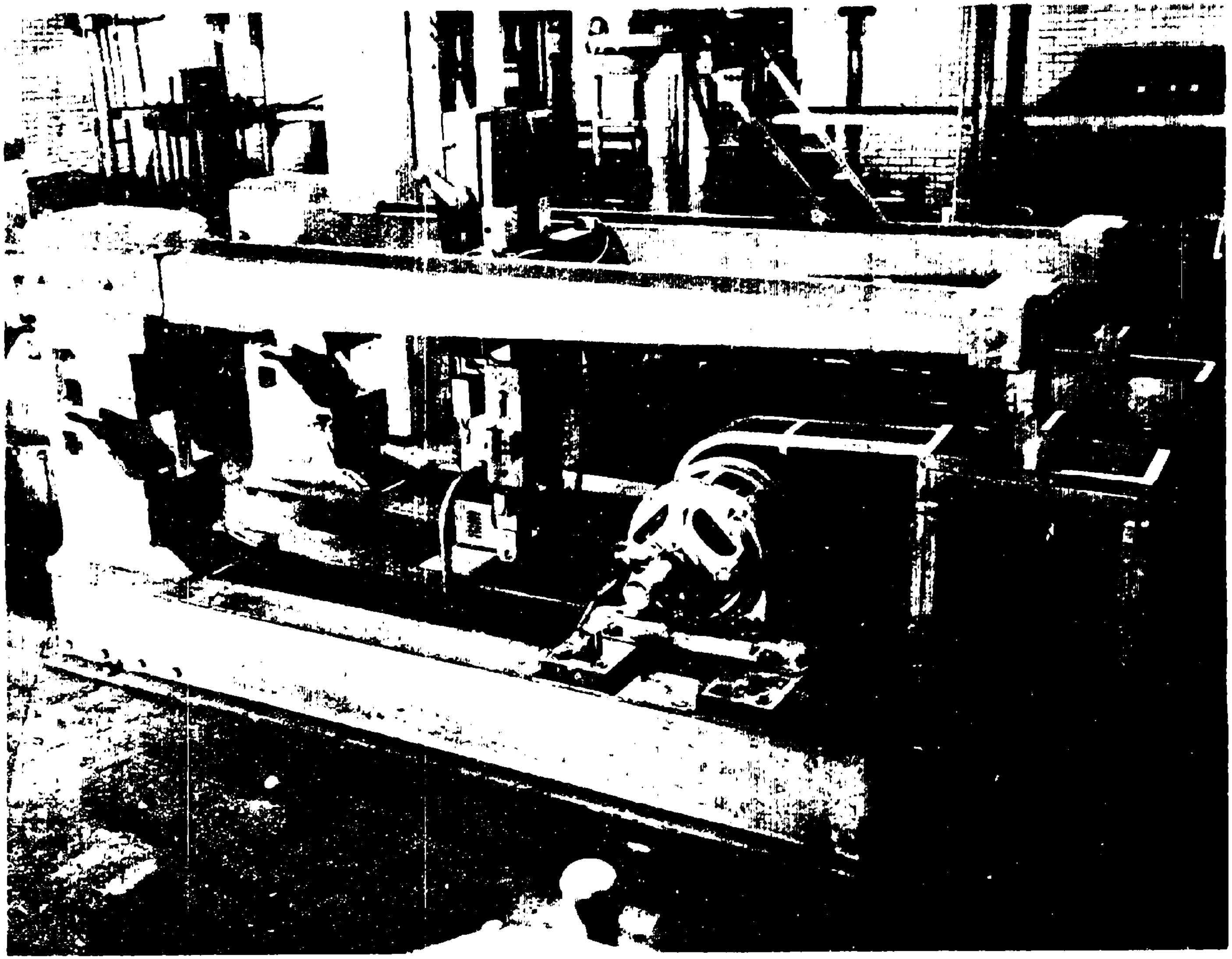
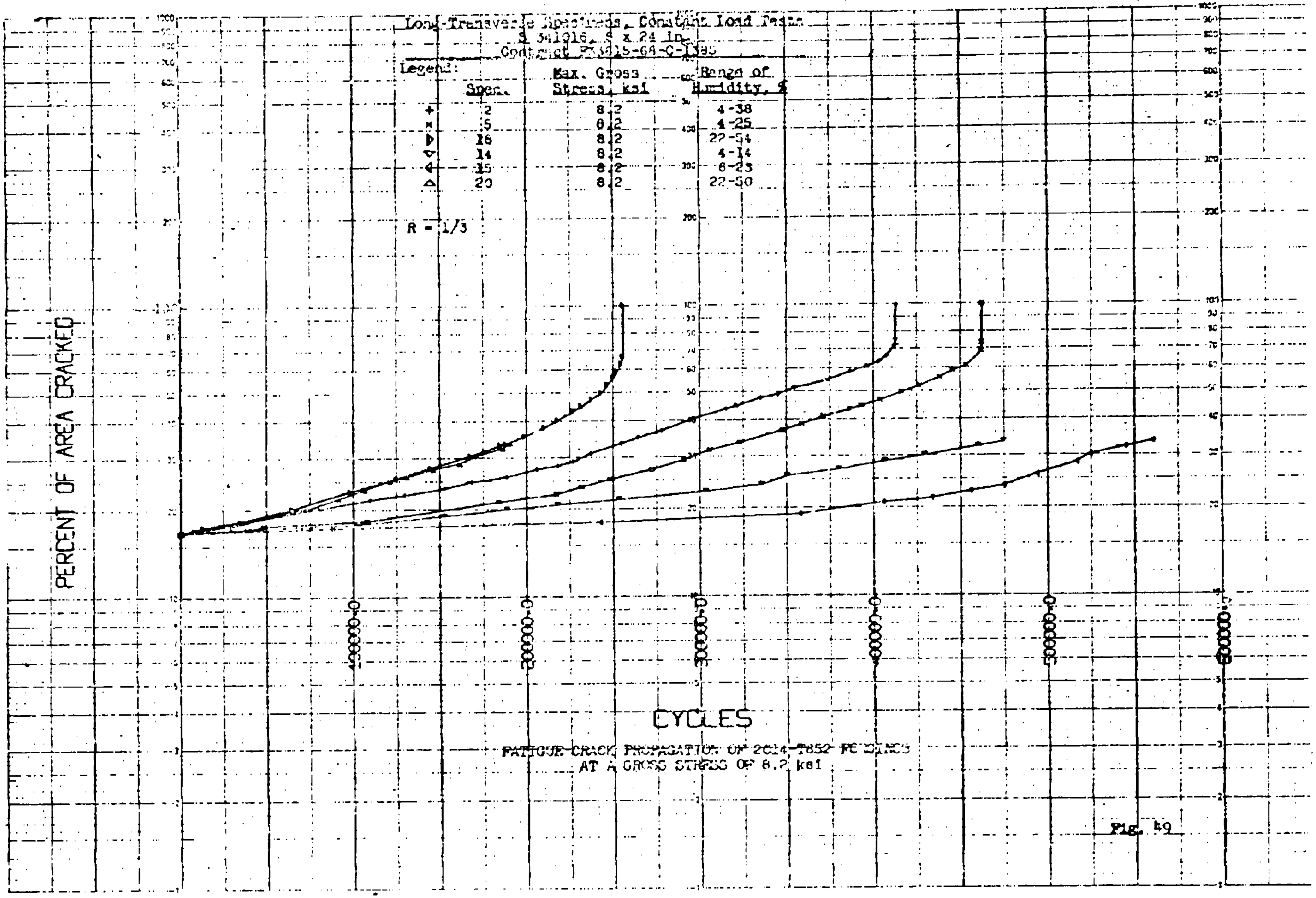


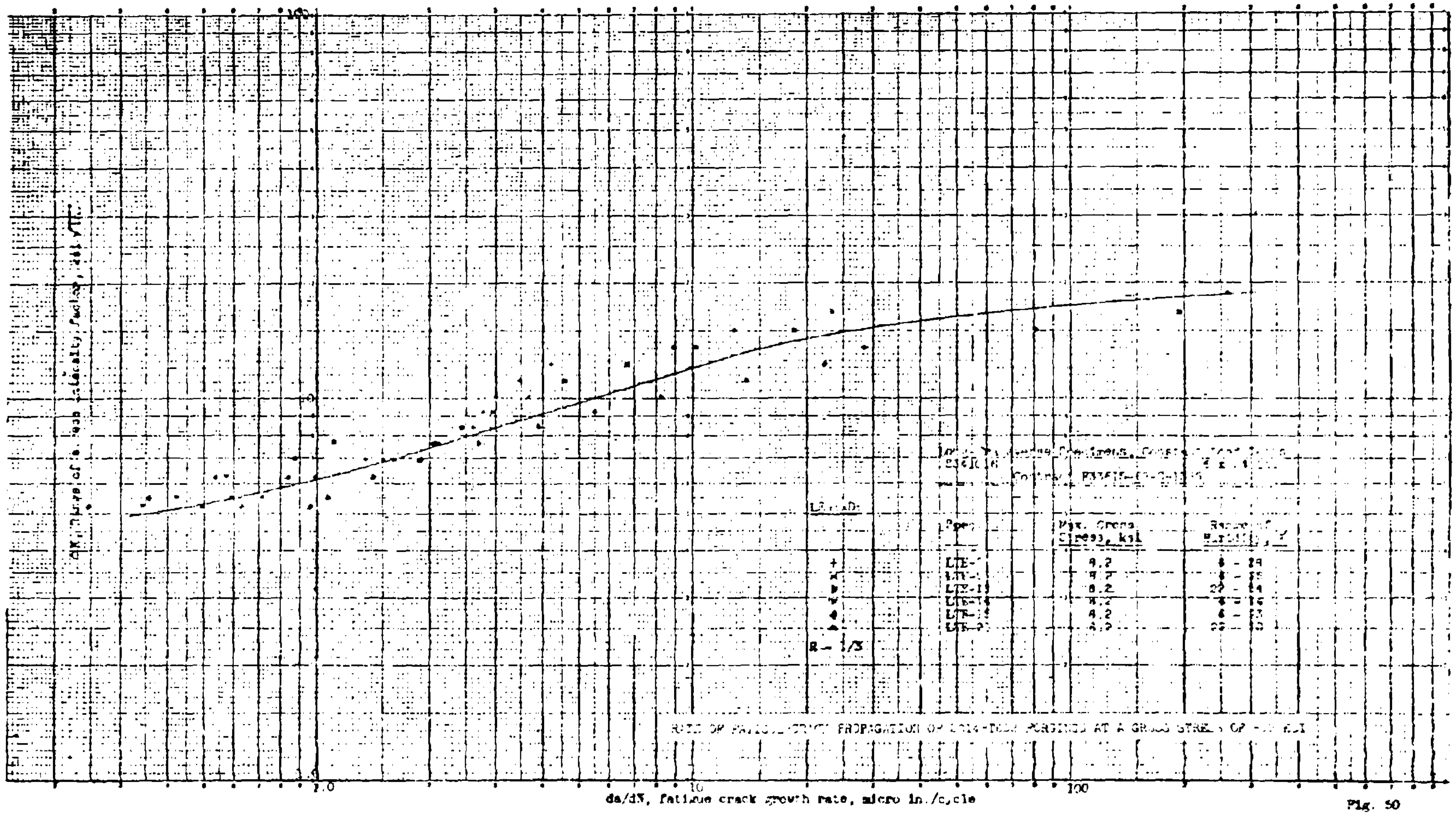
Fig. 47   50 000-lb Structural Fatigue Machine Used for Crack Propagation Studies.

Fig. 48 Fixtures for Crack Propagation Tests of Short-Transverse Specimens



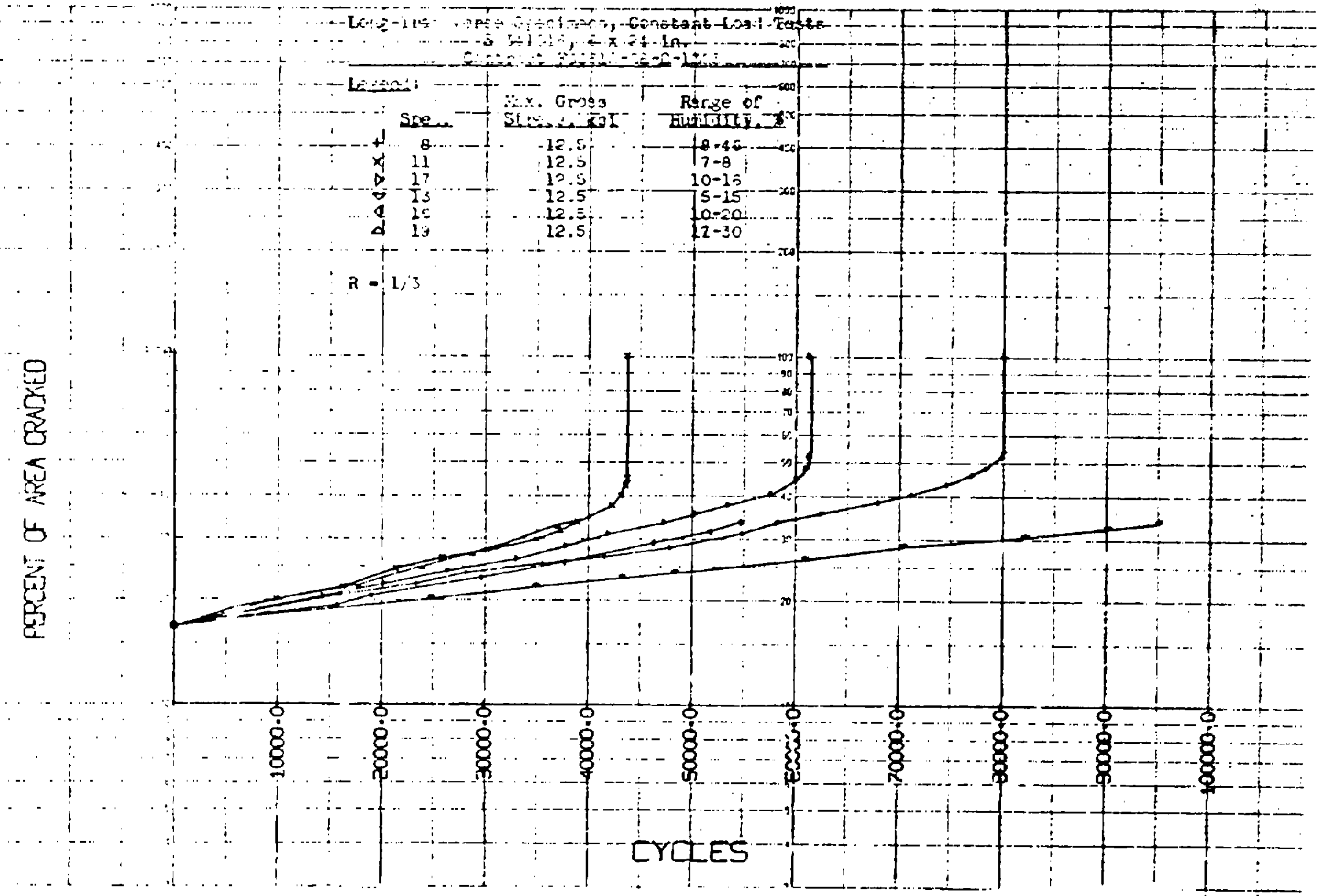

FATIGUE-CRACK PROPAGATION OF 2014-T852 FORGINGS AT A GROSS STRESS OF 8.2 ksi

Fig. 49



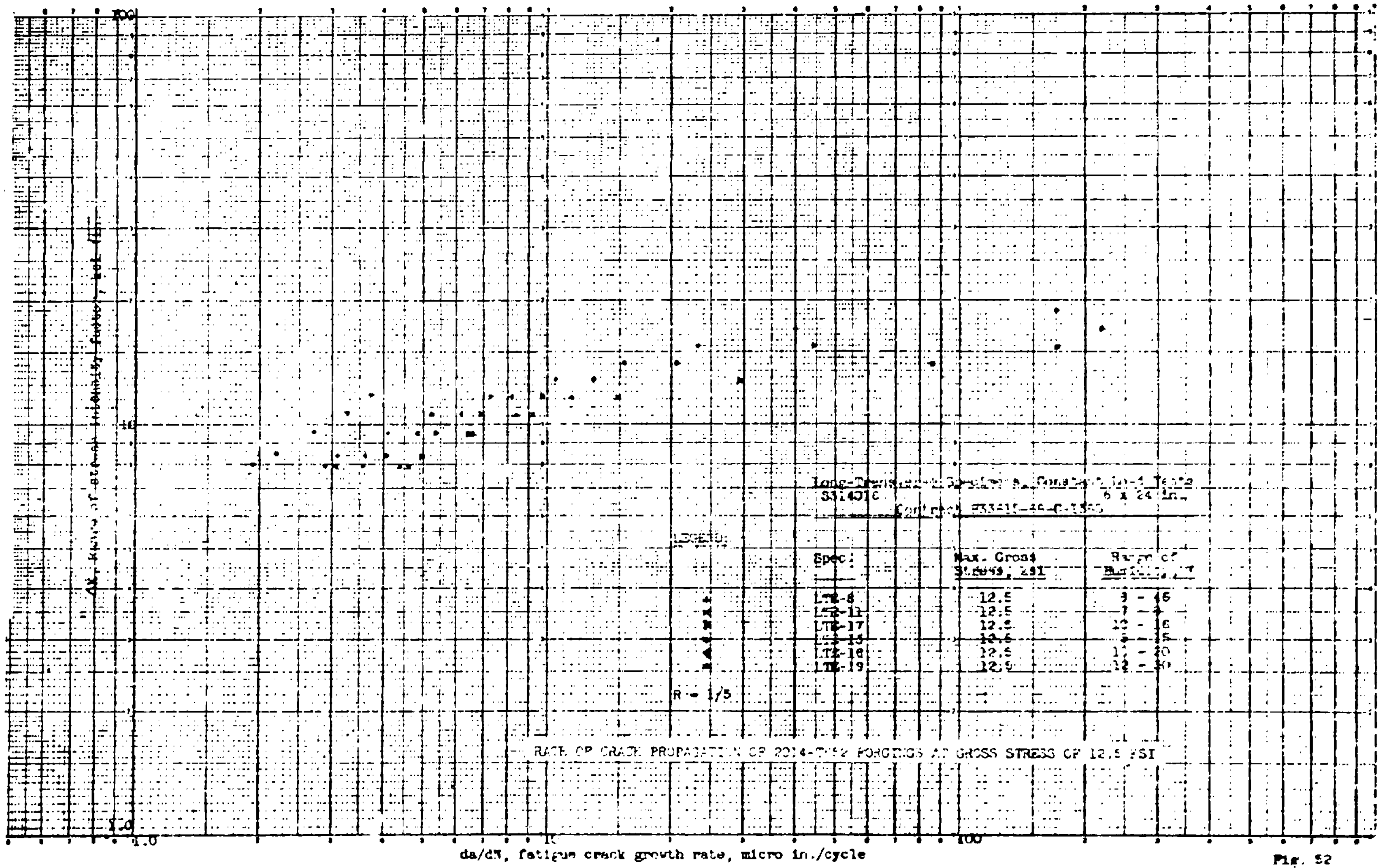
da/dN, fatigue crack growth rate, micro in./cycle
1.0
10
100
Max. Gross Stress, ksi


Fig. 50



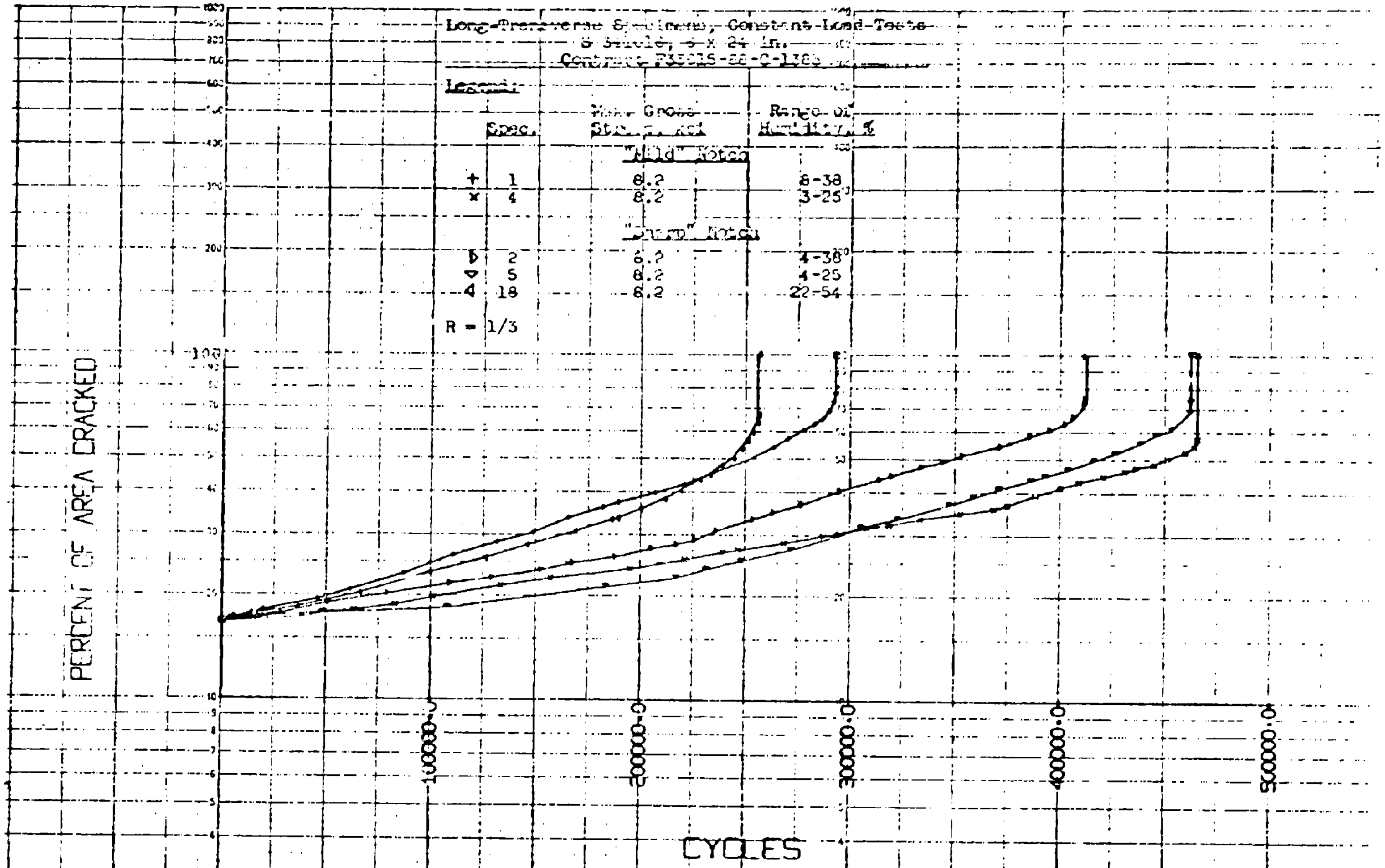

FATIGUE-CRACK PROPAGATION OF 2014-T652 FORGINGS AT A GROSS STRESS OF 12.5 ksi

Fig. 51



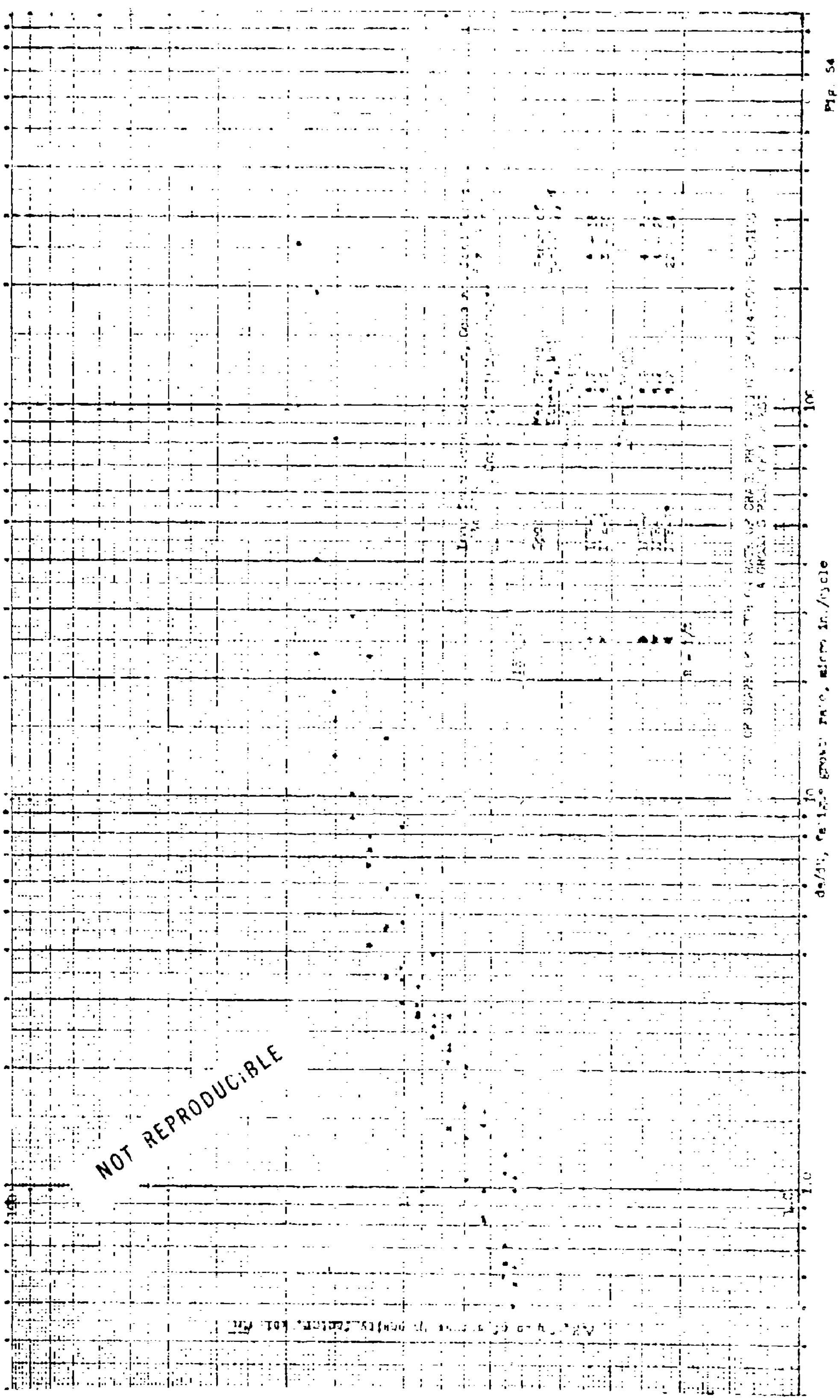
Spec.
Max. Gross Stress, ksi
LTE-8
LTE-11
LTE-17
LTE-18
LTE-19
12.5
12.5
12.5
12.6
12.5
12.5
3 - 16
7 - 8
12 - 16
11 - 20
12 - 20
R = 1/5
100
10
1.0
da/dN, fatigue crack growth rate, micro in./cycle


Fig. 52

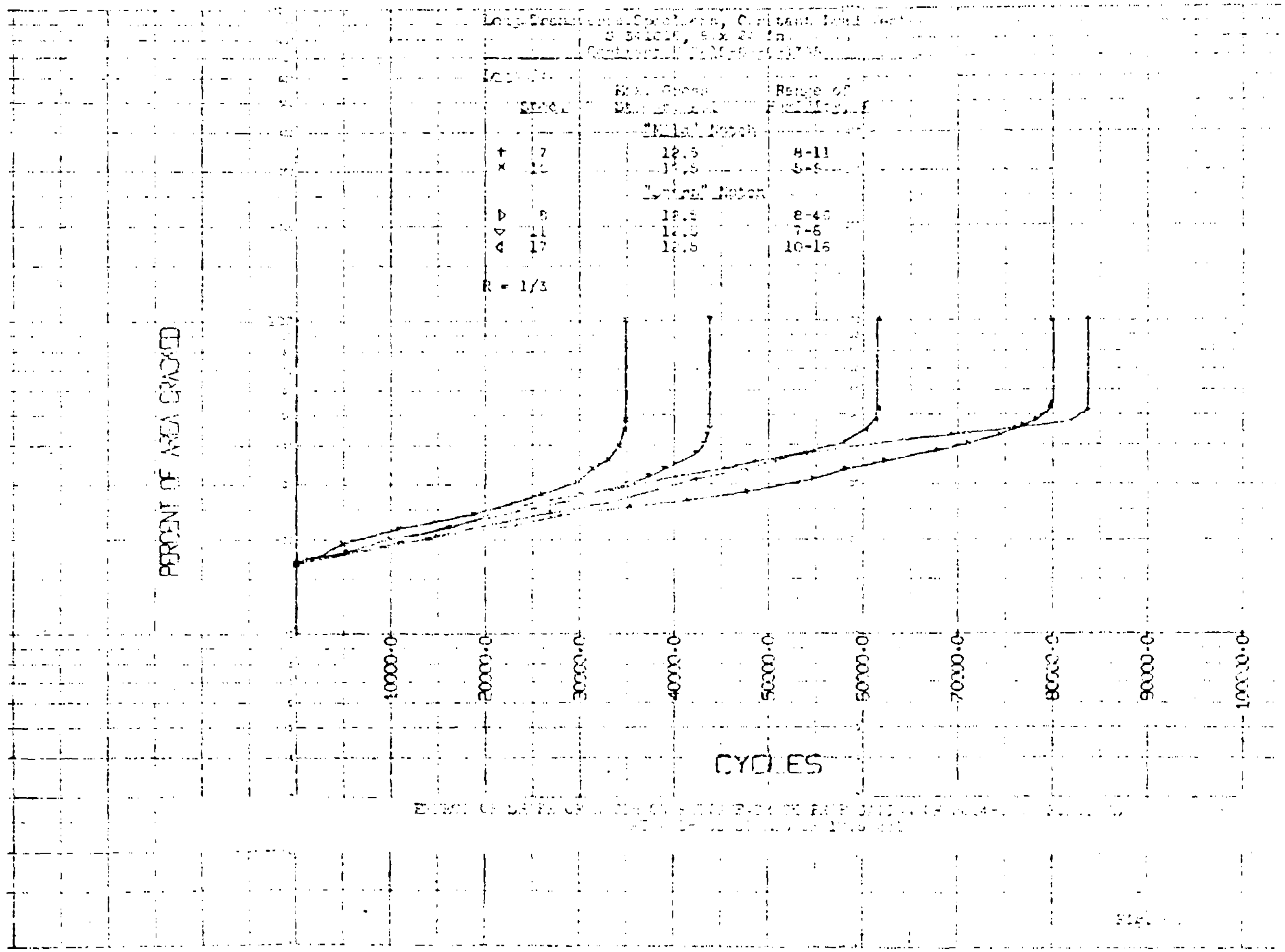


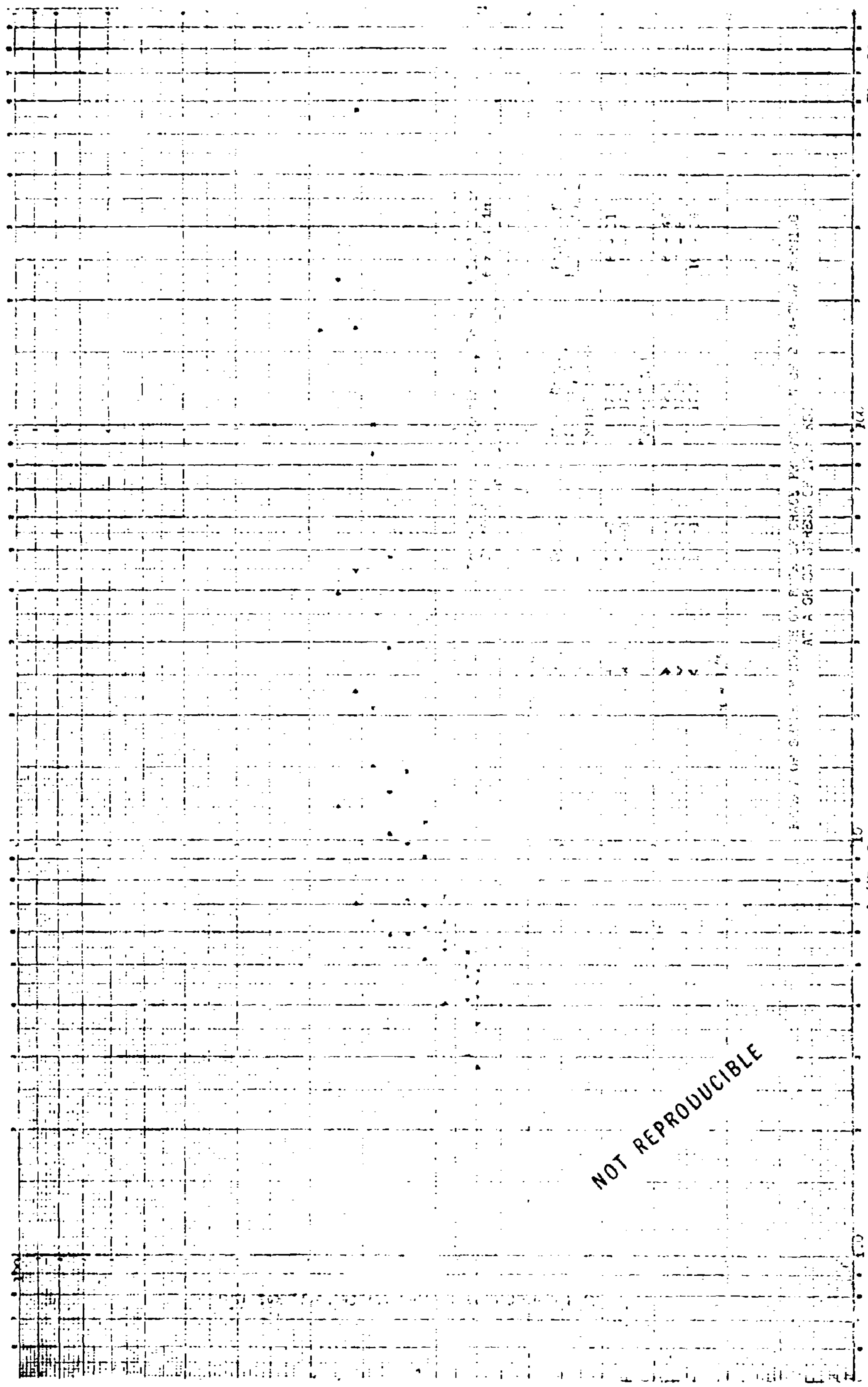

EFFECT OF SHAPE OF NOTCH ON FATIGUE CRACK PROPAGATION OF 2014-T652 FORGINGS AT A GROSS STRESS OF 8.2 ksi

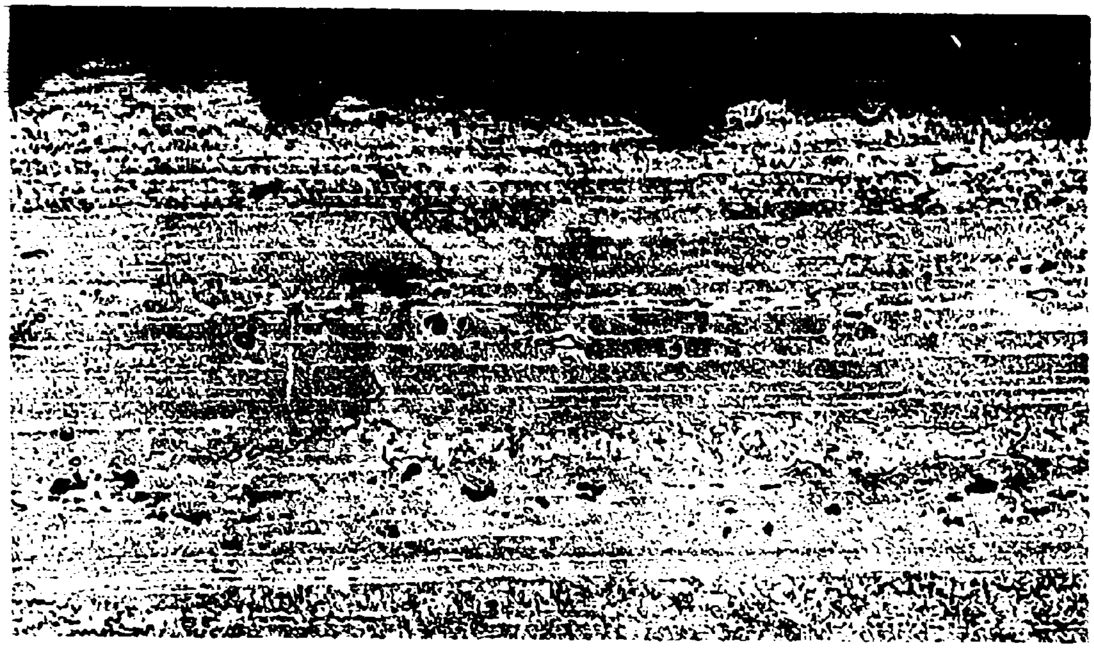
Fig. 53



NOT REPRODUCIBLE
1.0
10
100
da/dN, fatigue growth rate, micro in./cycle
Fig. 54


R = 1/3
8-11
8-45
7-6
10-16
PERCENT OF AREA CRACKED
10000.0
20000.0
30000.0
40000.0
50000.0
60000.0
70000.0
90000.0
CYCLES


100
10
micro in./cycle



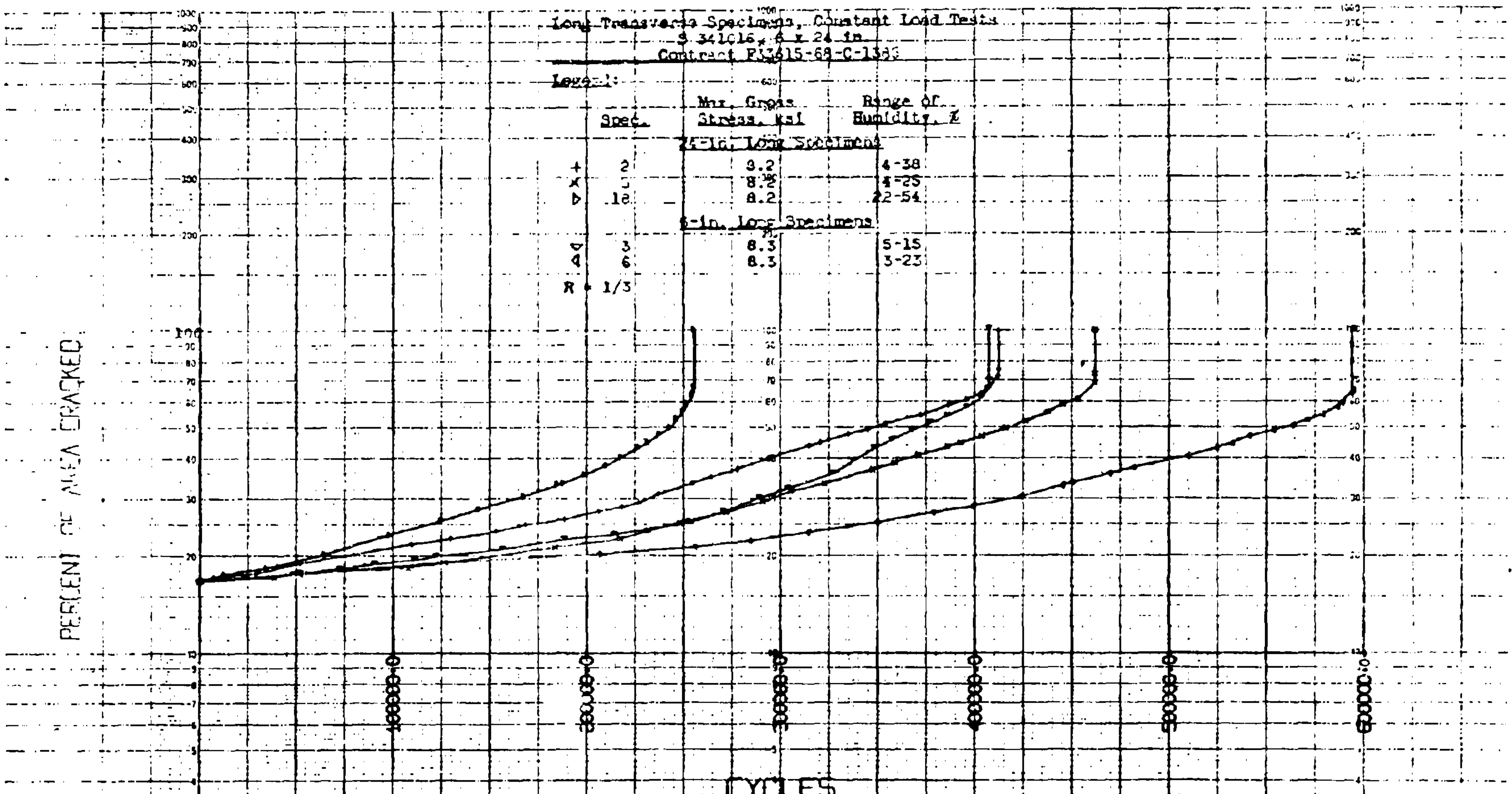
Spec. No. 341016-7 Keller's Etch Mag. 100X

Slow Propagation

Spec. No. 341016-10 Keller's Etch Mag. 100X

Fast Propagation

Fig. 57 Structure in the Surface Region of Fatigue Crack Propagation of 2014-T652 Specimens (Max. Gross Stress = 12.5 ksi)




EFFECT OF SPECIMEN LENGTH ON FATIGUE-CRACK PROPAGATION OF 2014-T652 FORGINGS, 8.2 ksi

Fig. 58

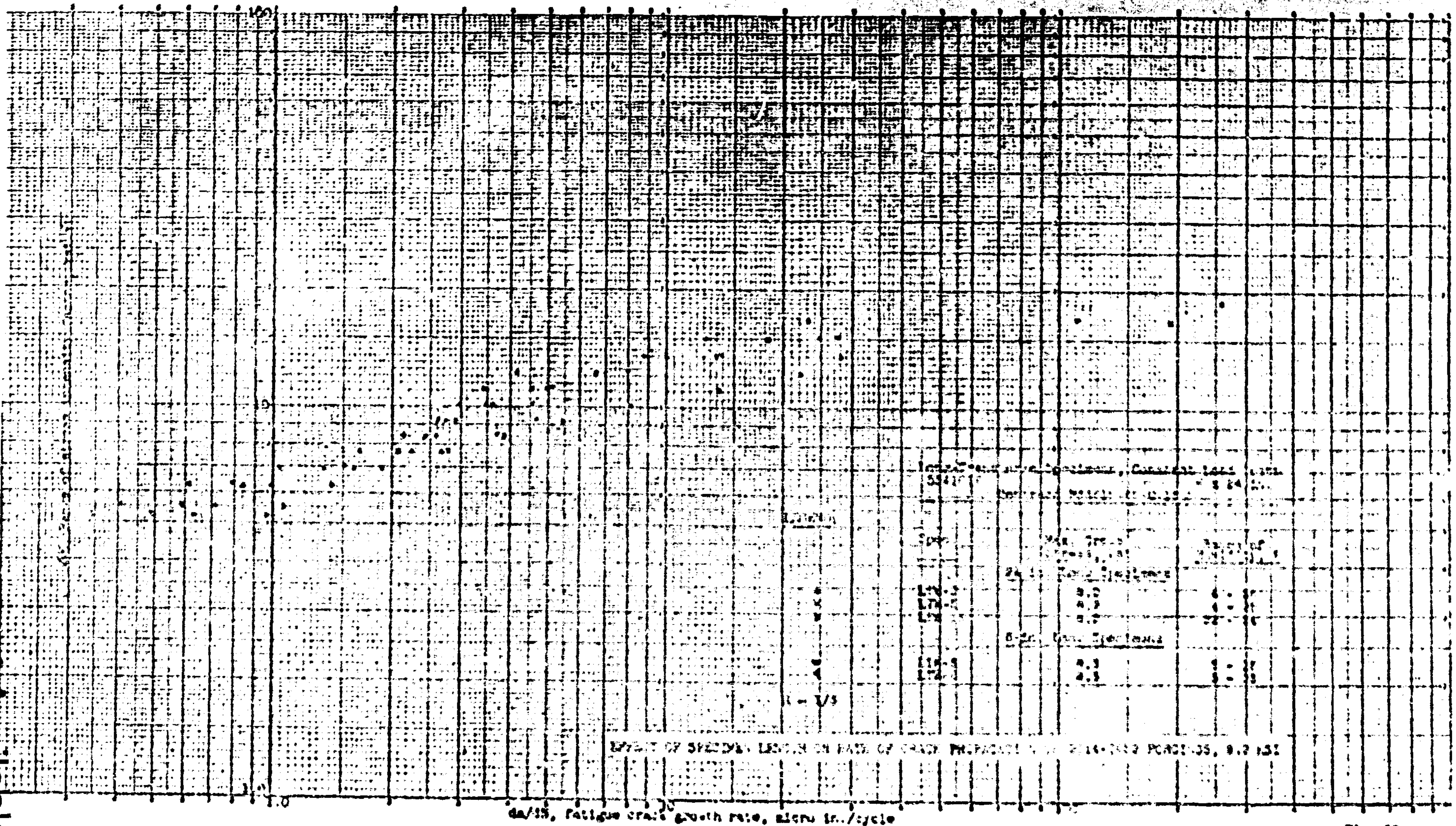



Fig. 59

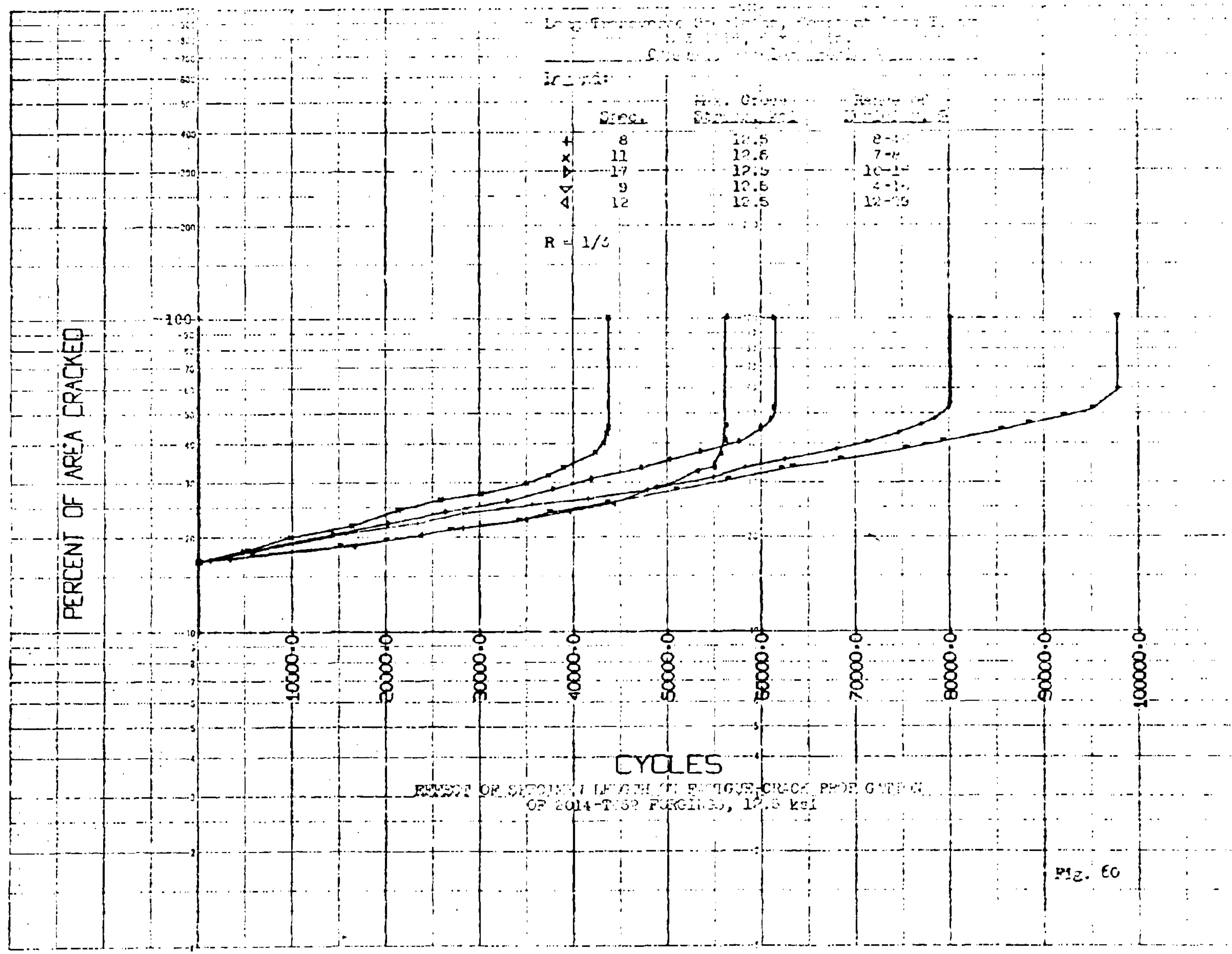
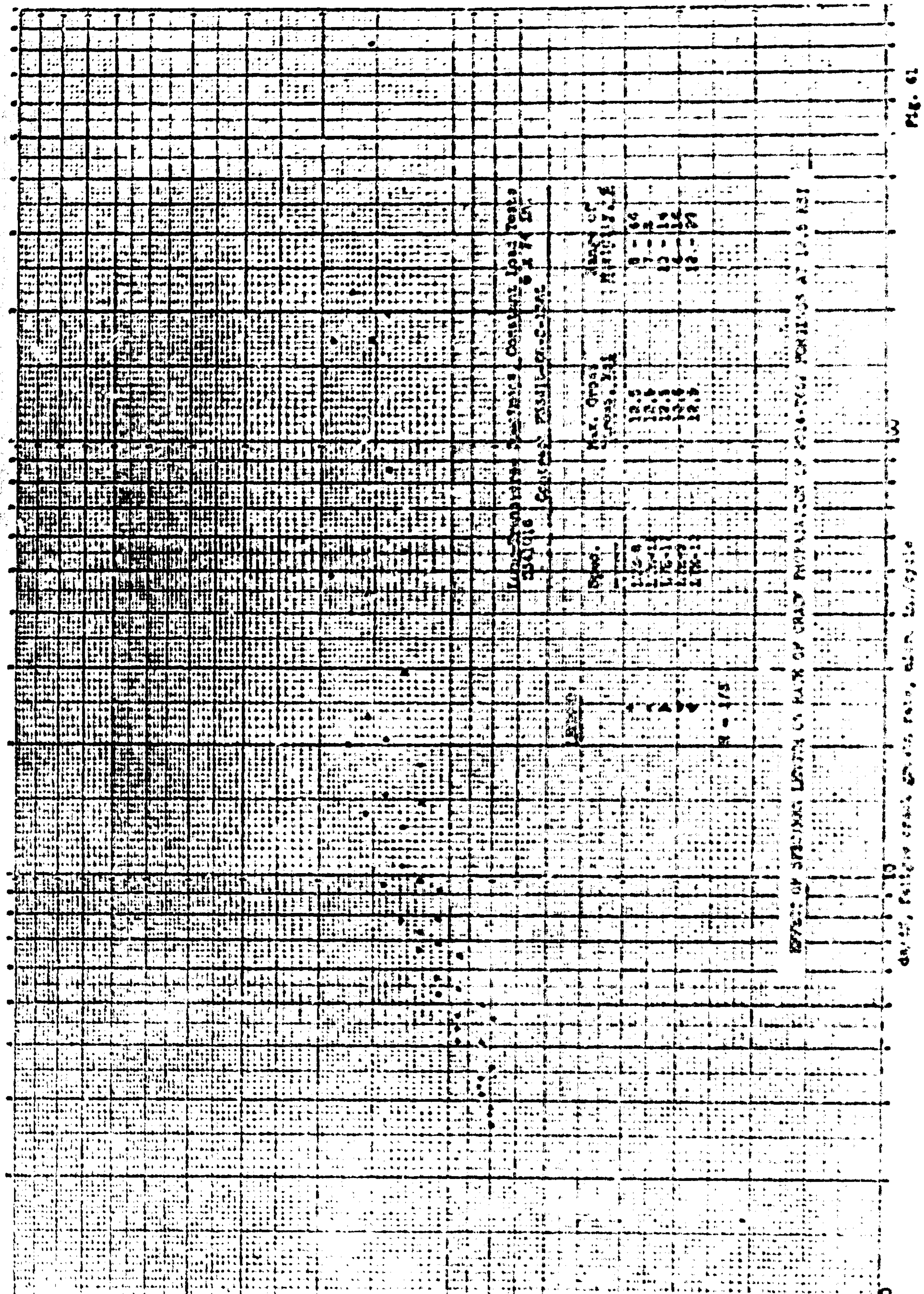
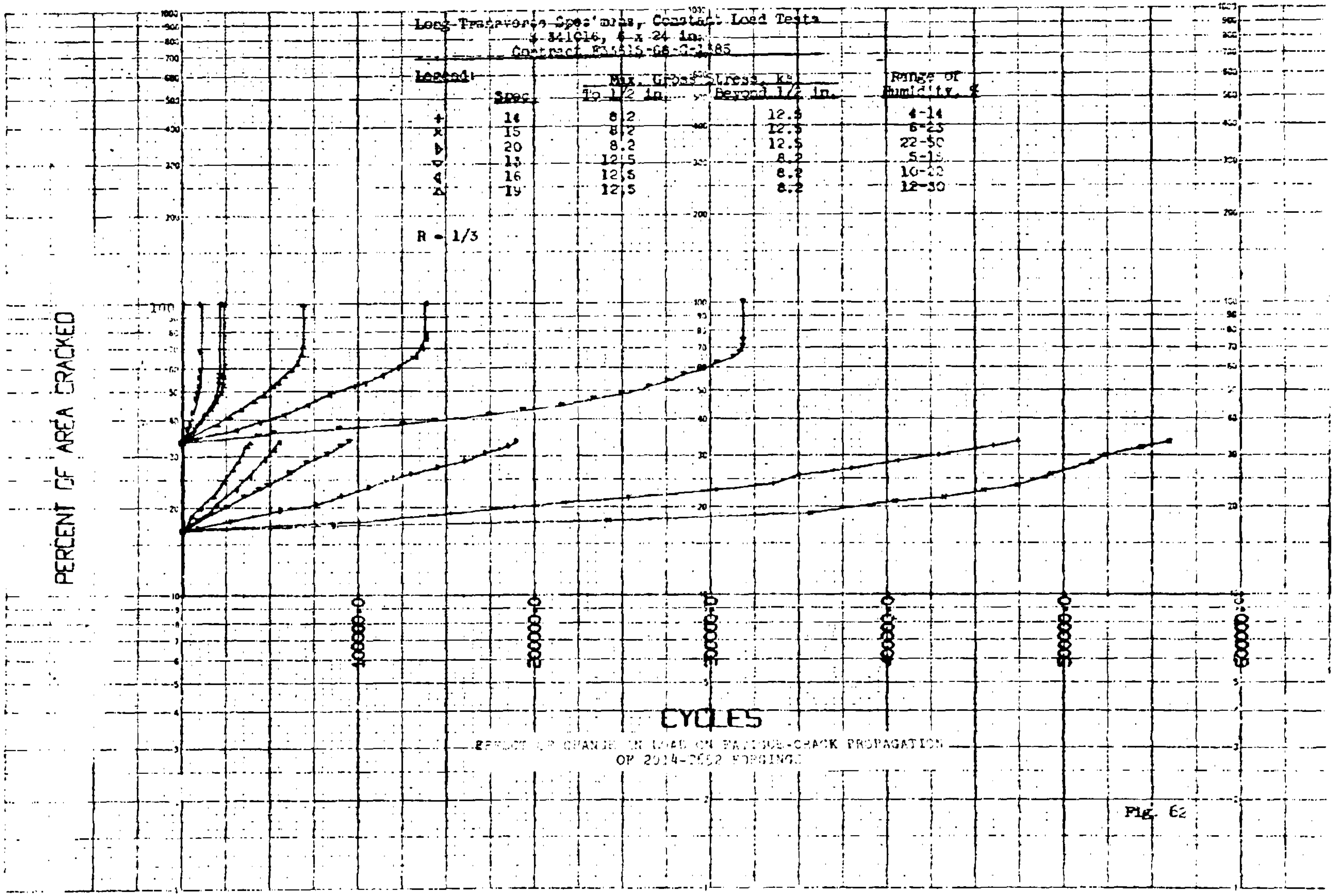

R = 1/3
Spec.
8
11
17
9
12
100
10
10000.0
20000.0
30000.0
40000.0
50000.0
60000.0
70000.0
80000.0
90000.0
100000.0
PERCENT OF AREA CRACKED
CYCLES
OF 2014-T6? FORGINGS, 12.5 ksi

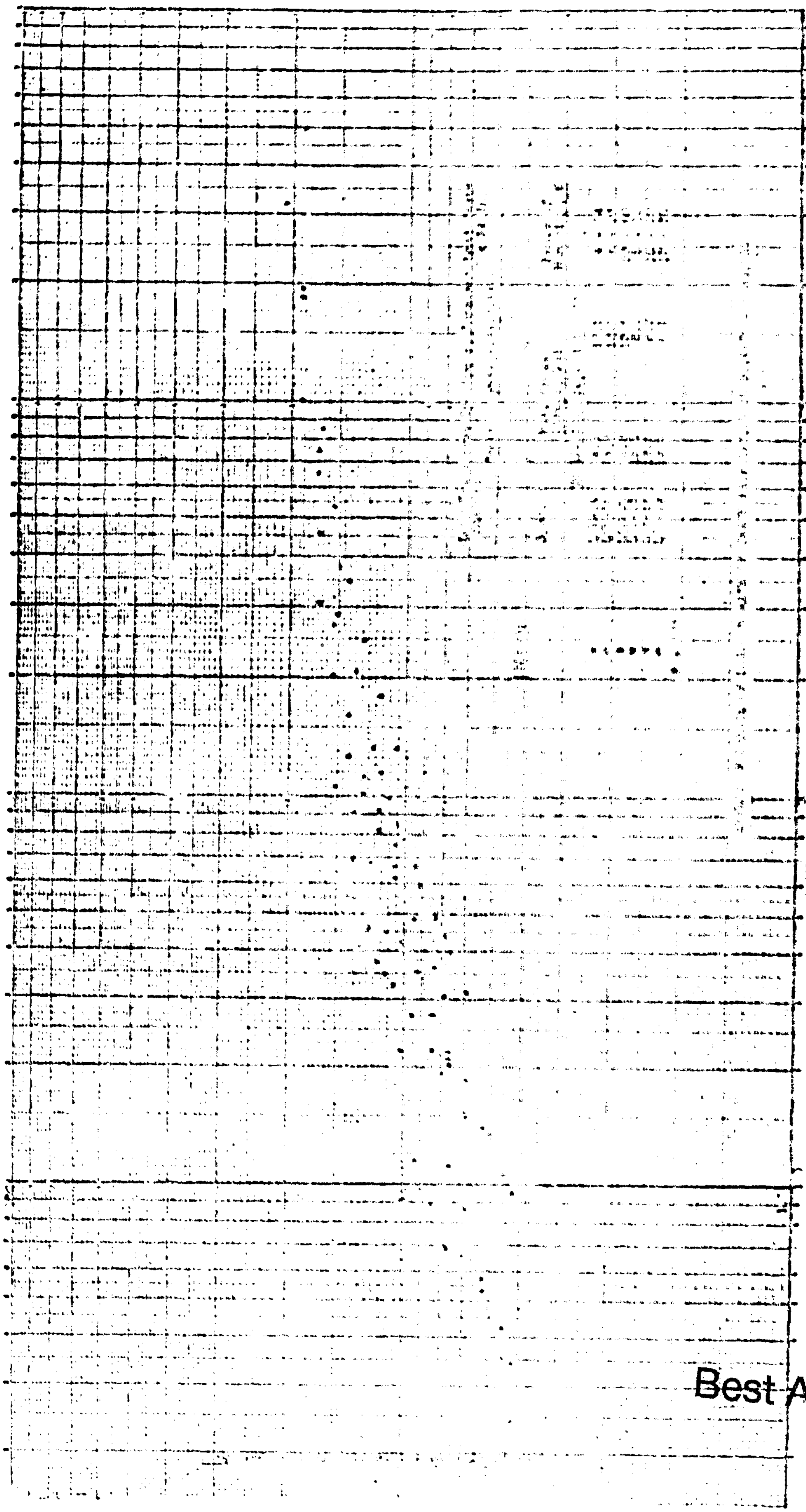
Fig. 60


Constant Load Tests
Spec.
Max. Gross
R = 1/5
10
Fig. 61




EFFECT OF CHANGE IN LOAD ON FATIGUE-CRACK PROPAGATION OF 2014-T652 FORGINGS

Fig. 62



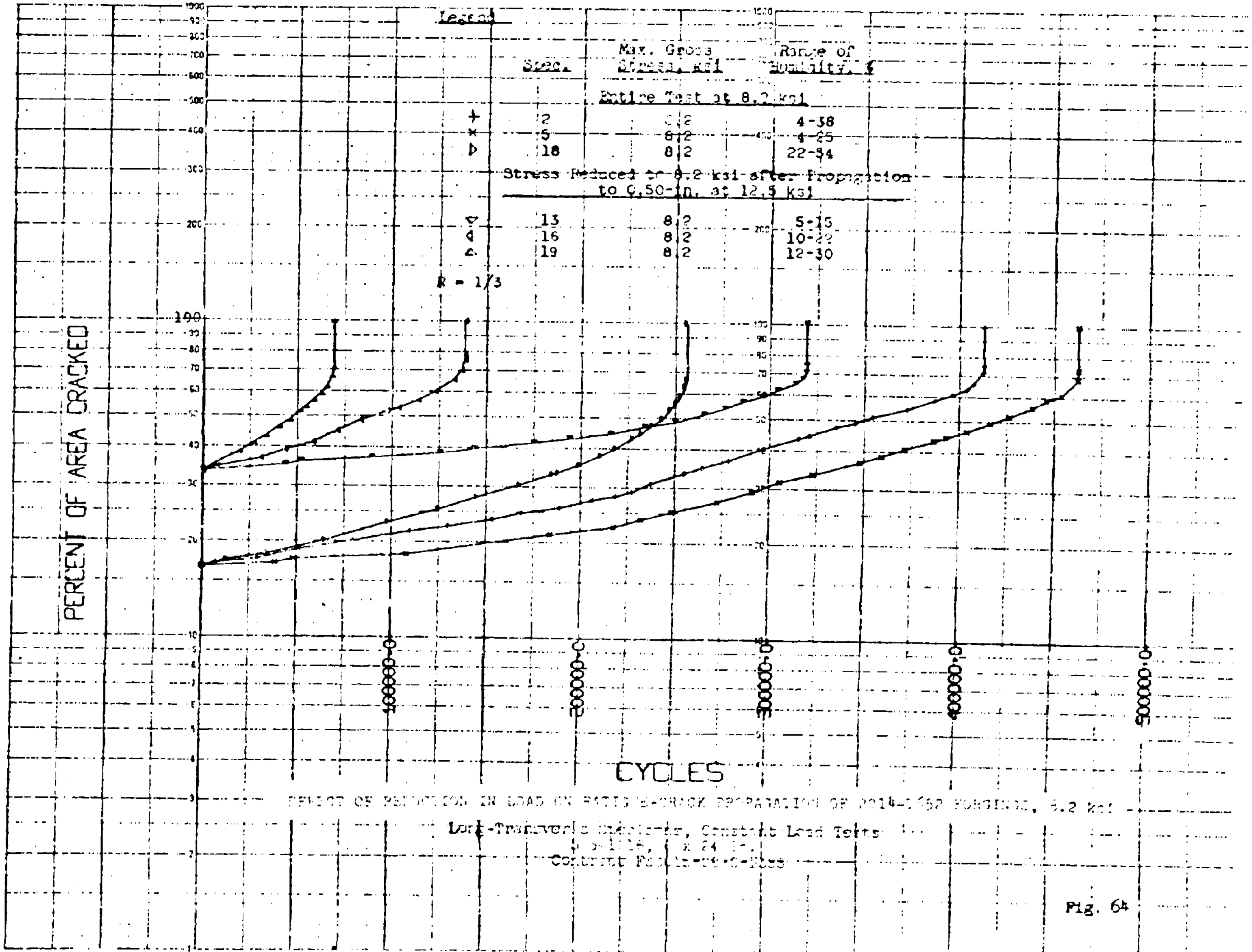
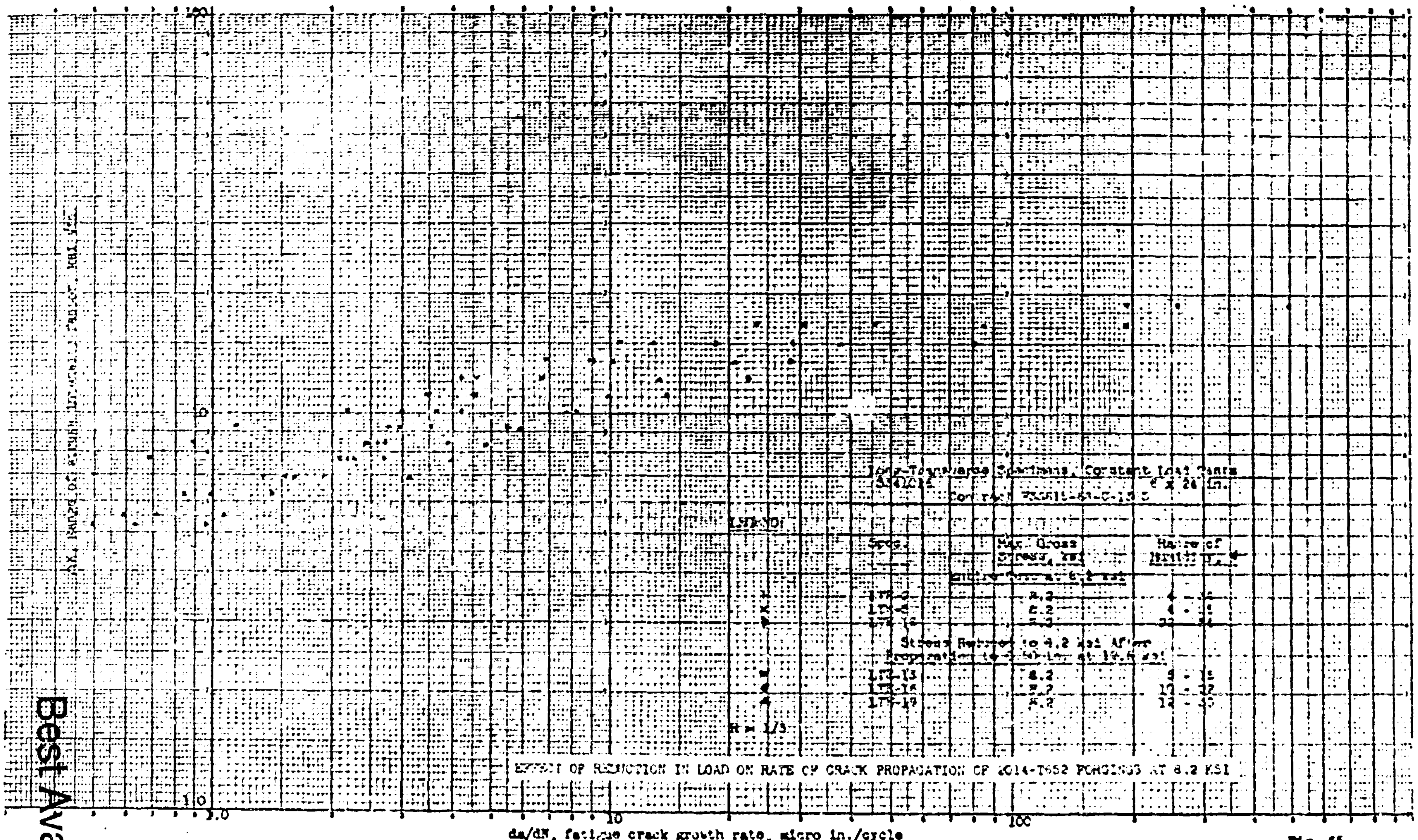
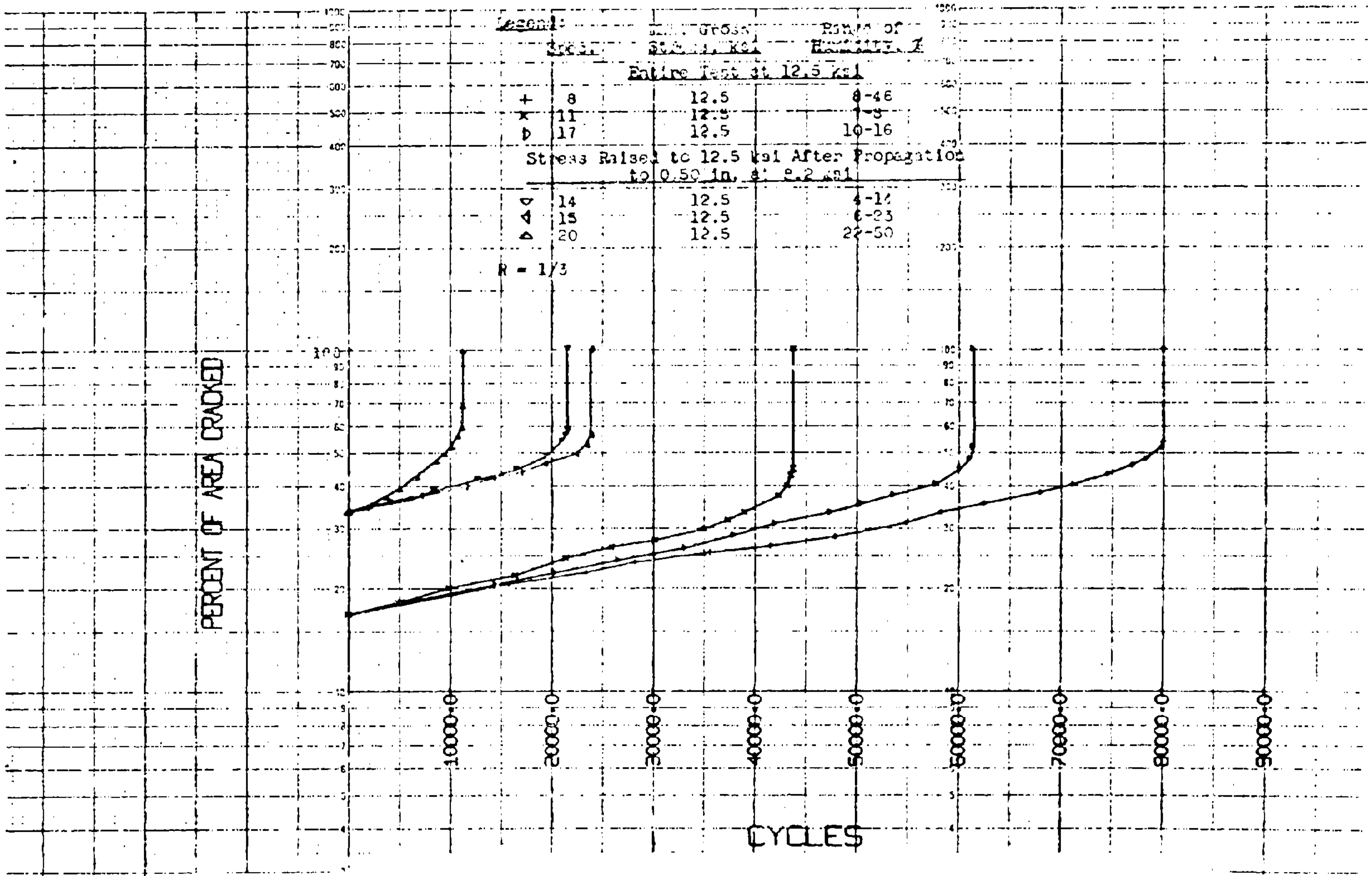

Legend
Spec.
Max. Gross Stress, ksi
Range of Humidity, %
Entire Test at 8.2 ksi
+ 2 8.2 4-38
× 5 8.2 4-25
▷ 18 8.2 22-54
Stress Reduced to 8.2 ksi after Propagation to 0.50-in. at 12.5 ksi
▽ 13 8.2 5-15
◁ 16 8.2 10-22
△ 19 8.2 12-30
R = 1/3
PERCENT OF AREA CRACKED
CYCLES
100000.0
200000.0
300000.0
400000.0
500000.0
Long-Transverse Direction, Constant Load Tests

Fig. 64




EFFECT OF REDUCTION IN LOAD ON RATE OF CRACK PROPAGATION OF 2014-T652 FORGINGS AT 8.2 KSI

Fig. 65




EFFECT OF INCREASE OF LOAD ON FATIGUE-CRACK PROPAGATION OF 2014-T652 FORGINGS

Long-Transverse Specimens, Constant Load Tests
B 341016, 6 x 24 in.
Contract F33615-65-C-1385

Fig. 66

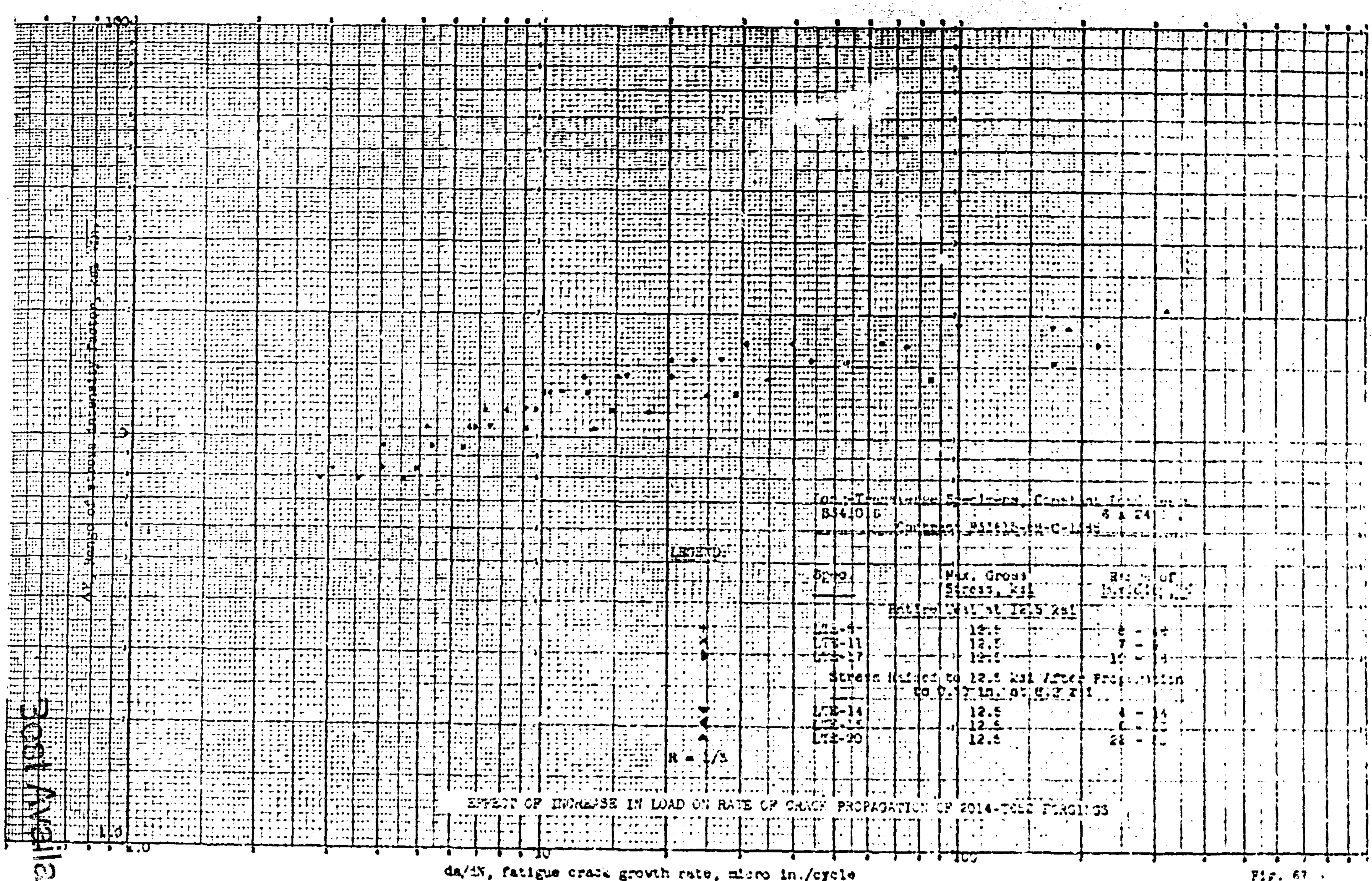
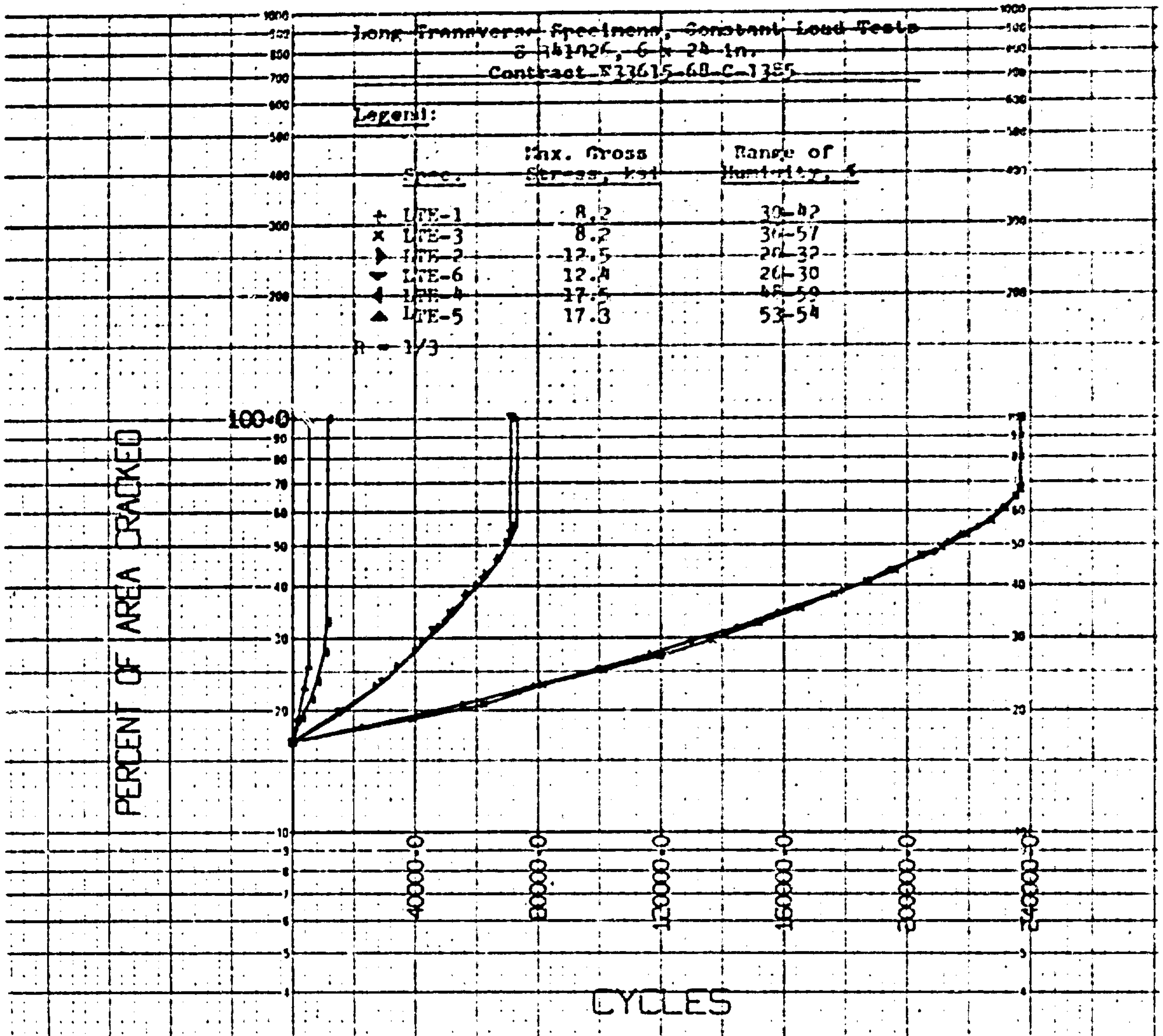

EFFECT OF INCREASE IN LOAD ON RATE OF CRACK PROPAGATION OF 2014-T652 FORGINGS
LEGEND:
R = 1/3
Max. Gross Stress, ksi
Stress Raised to 12.5 ksi After Propagation
da/dN, fatigue crack growth rate, micro in./cycle
1.0
10
100

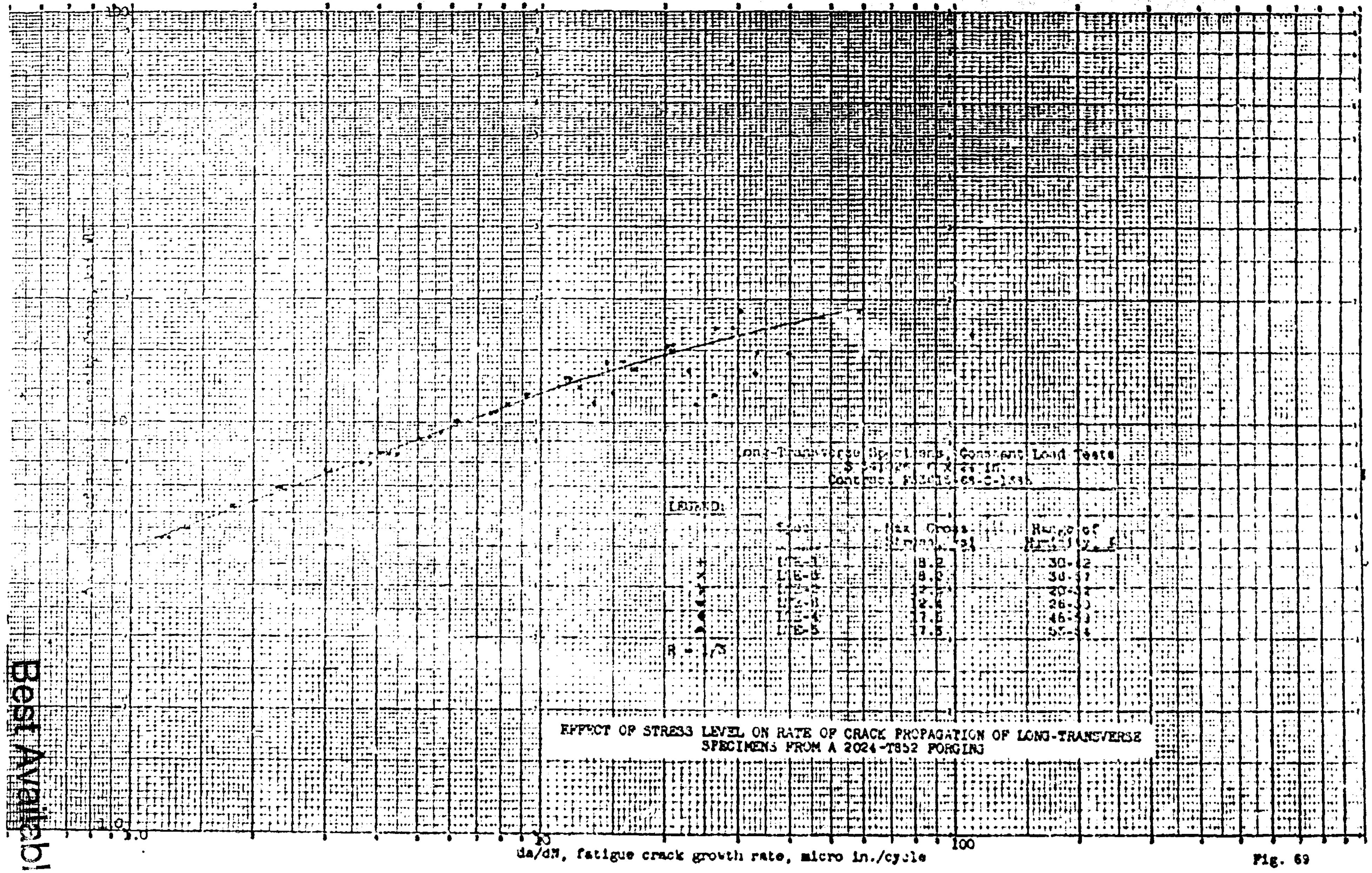
Fig. 67




EFFECT OF STRESS LEVEL ON FATIGUE-CRACK PROPAGATION OF LONG-TRANSVERSE SPECIMENS FROM 2024-T852 FORGINGS

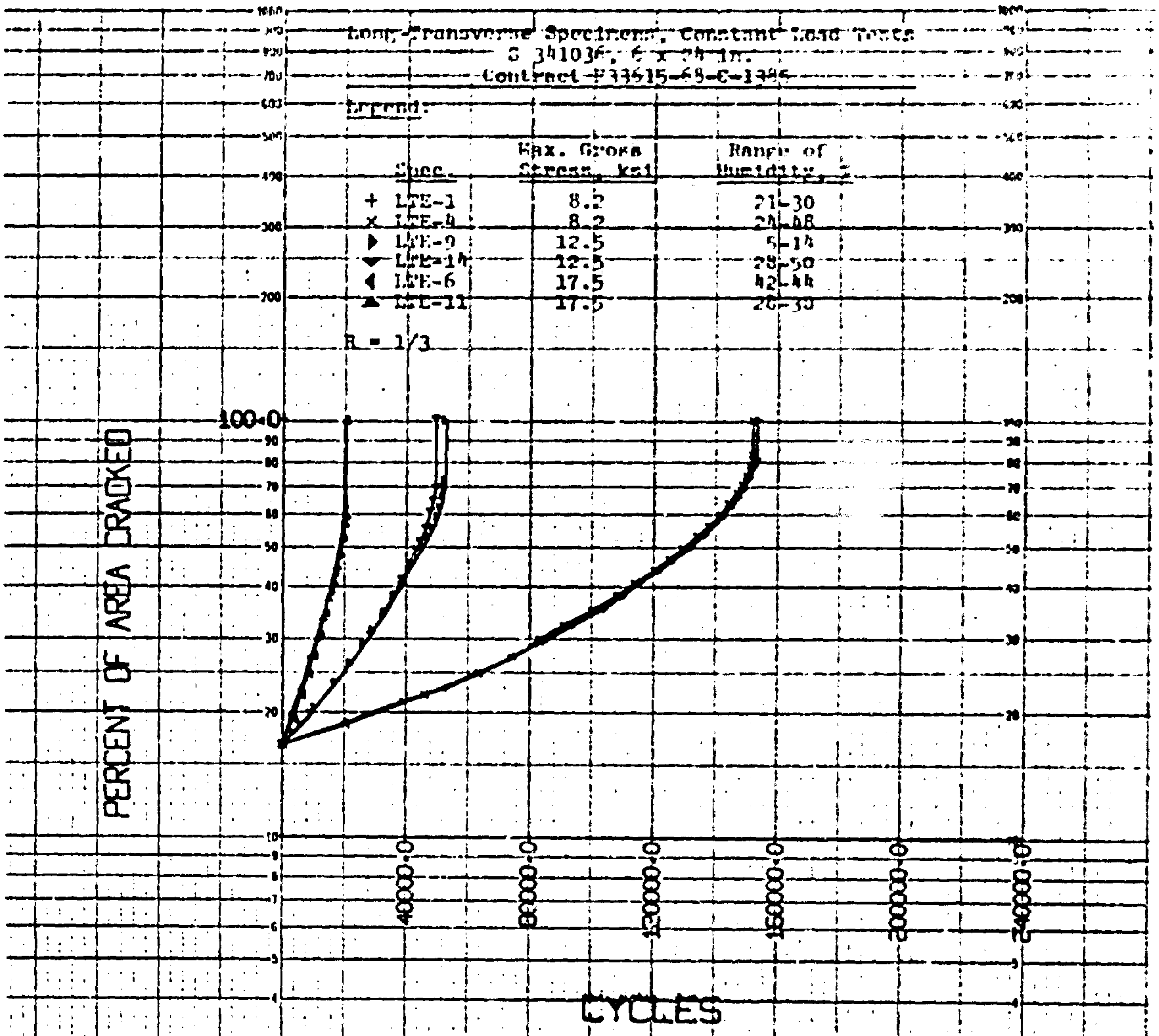
Fig. 68

Best Available Copy



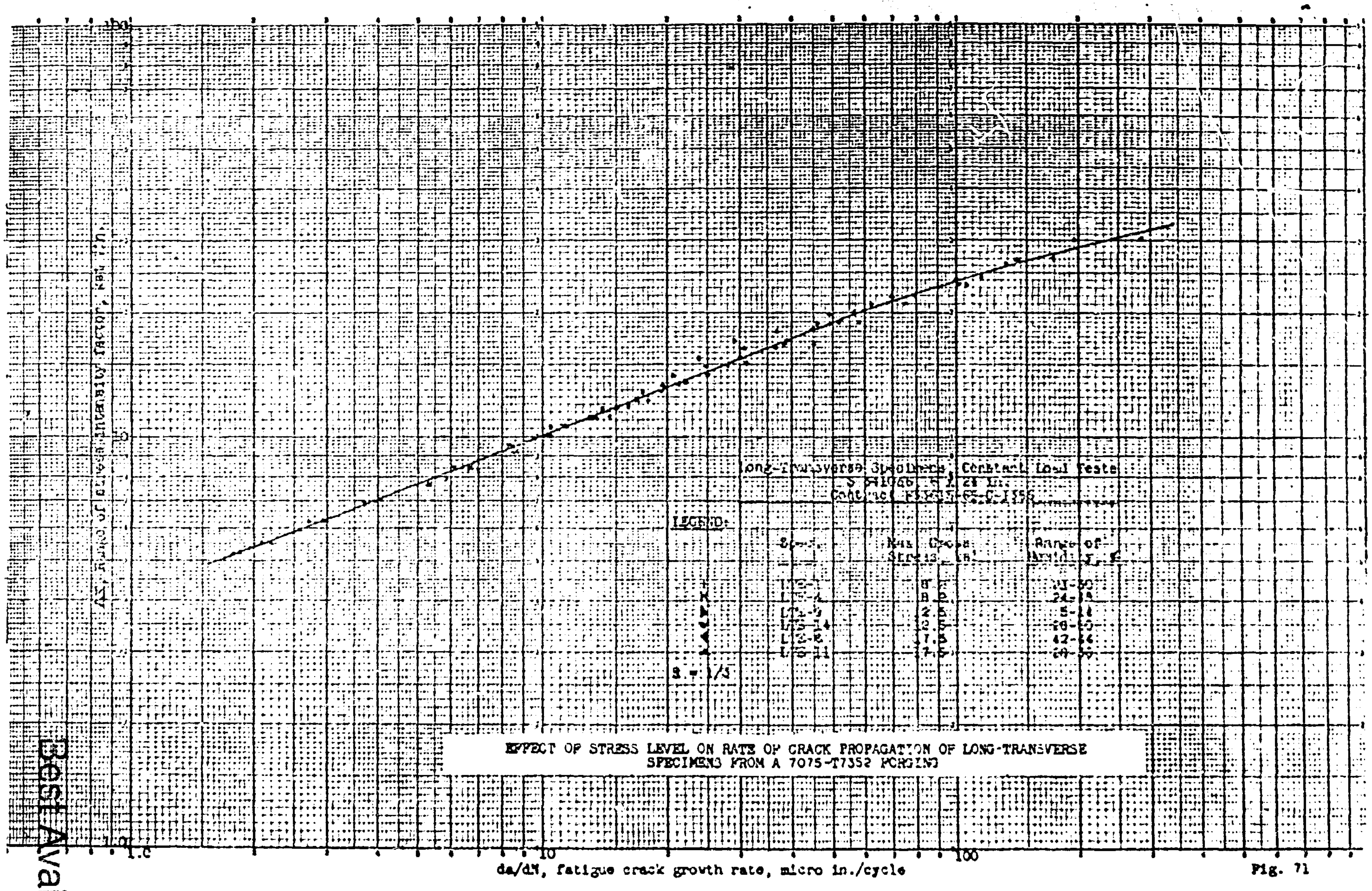
EFFECT OF STRESS LEVEL ON RATE OF CRACK PROPAGATION OF LONG-TRANSVERSE SPECIMENS FROM A 2024-T852 FORGING
LEGEND:
R = 1/3
1.0
10
100
da/dN, fatigue crack growth rate, micro in./cycle


Fig. 69



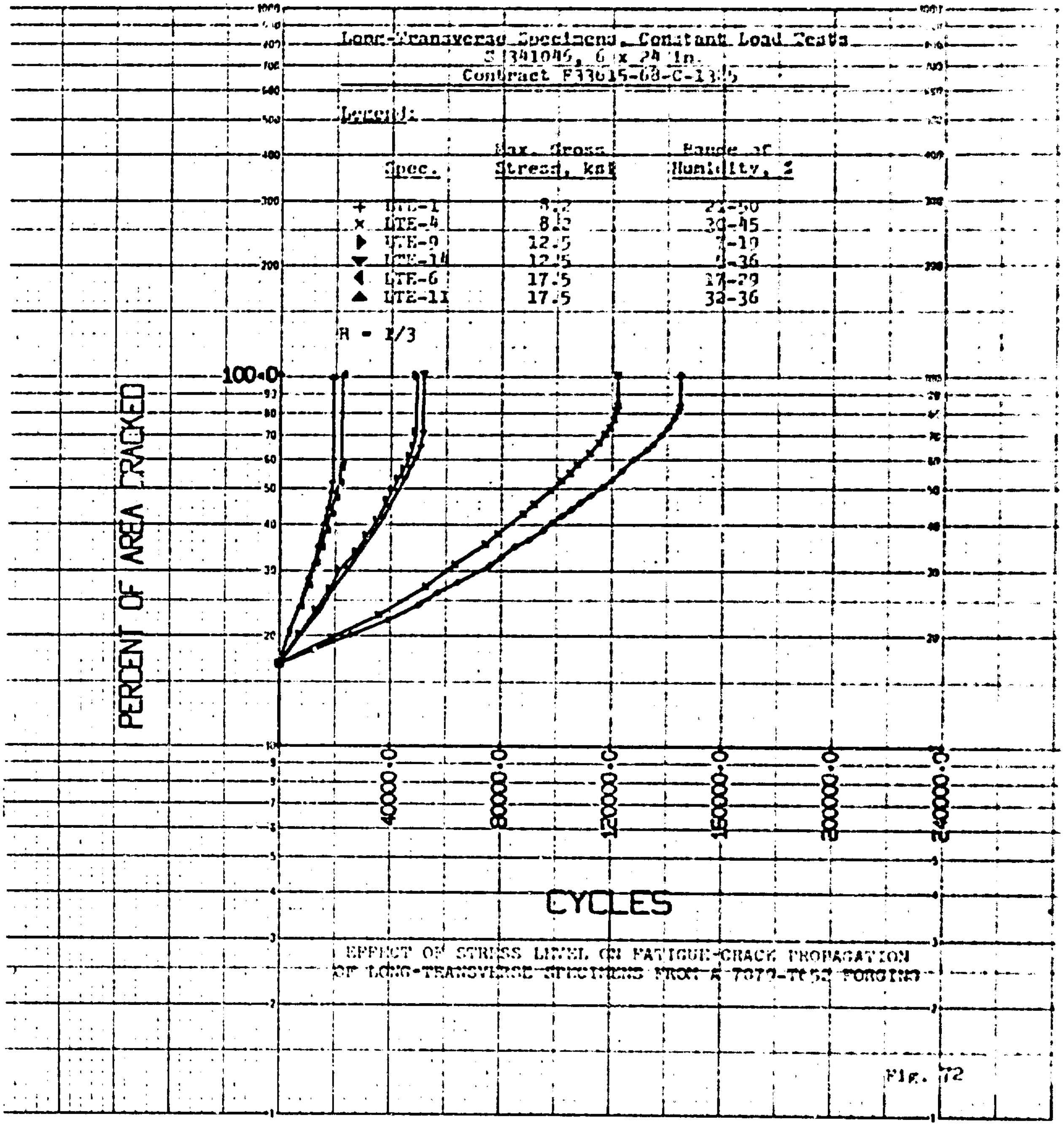

EFFECT OF STRESS LEVEL ON FATIGUE-CRACK PROPAGATION OF LONG-TRANSVERSE SPECIMENS FROM A 7075-T7352 FORGING

Fig. 70



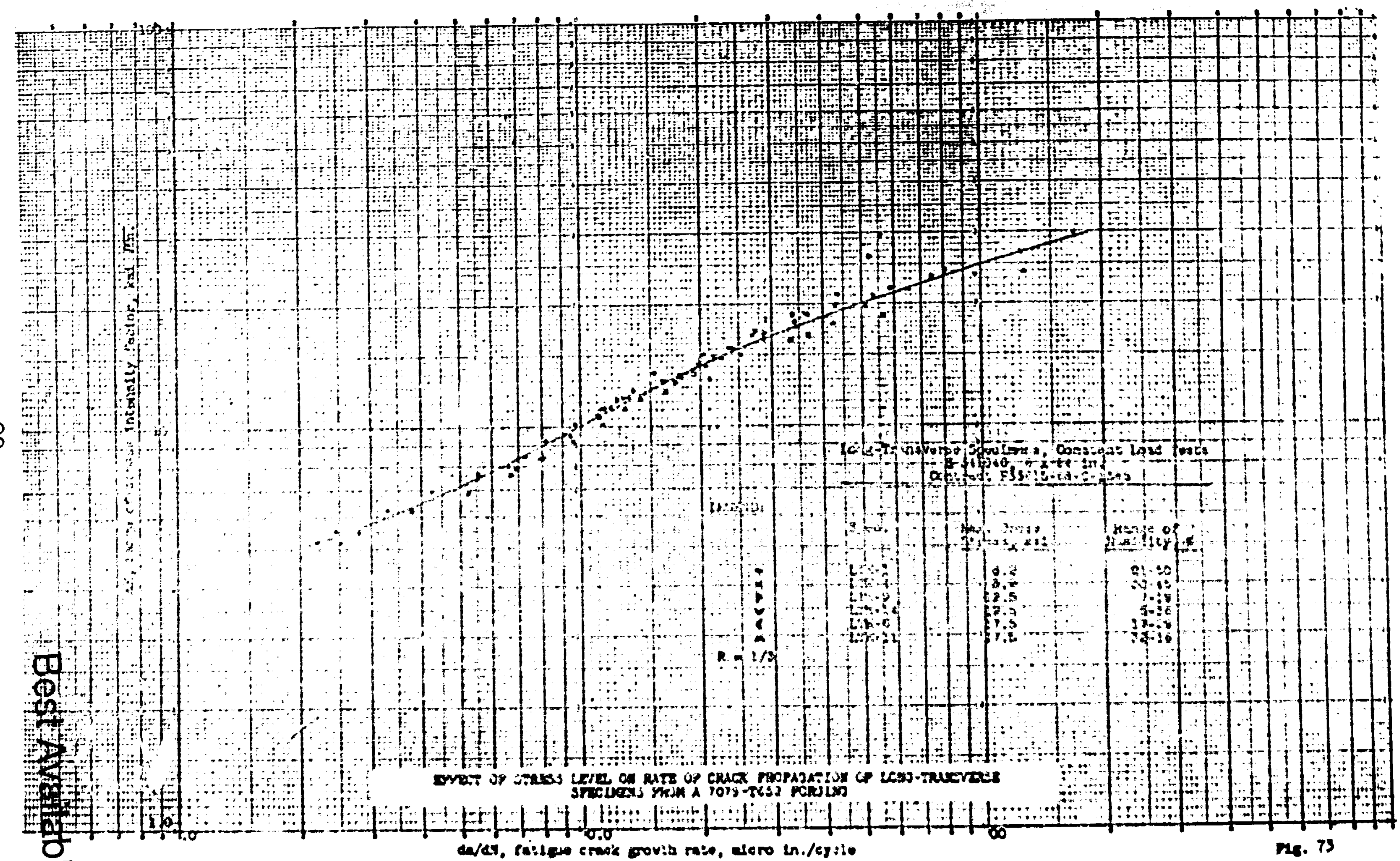

EFFECT OF STRESS LEVEL ON RATE OF CRACK PROPAGATION OF LONG-TRANSVERSE SPECIMENS FROM A 7075-T7352 FORGING

Fig. 71



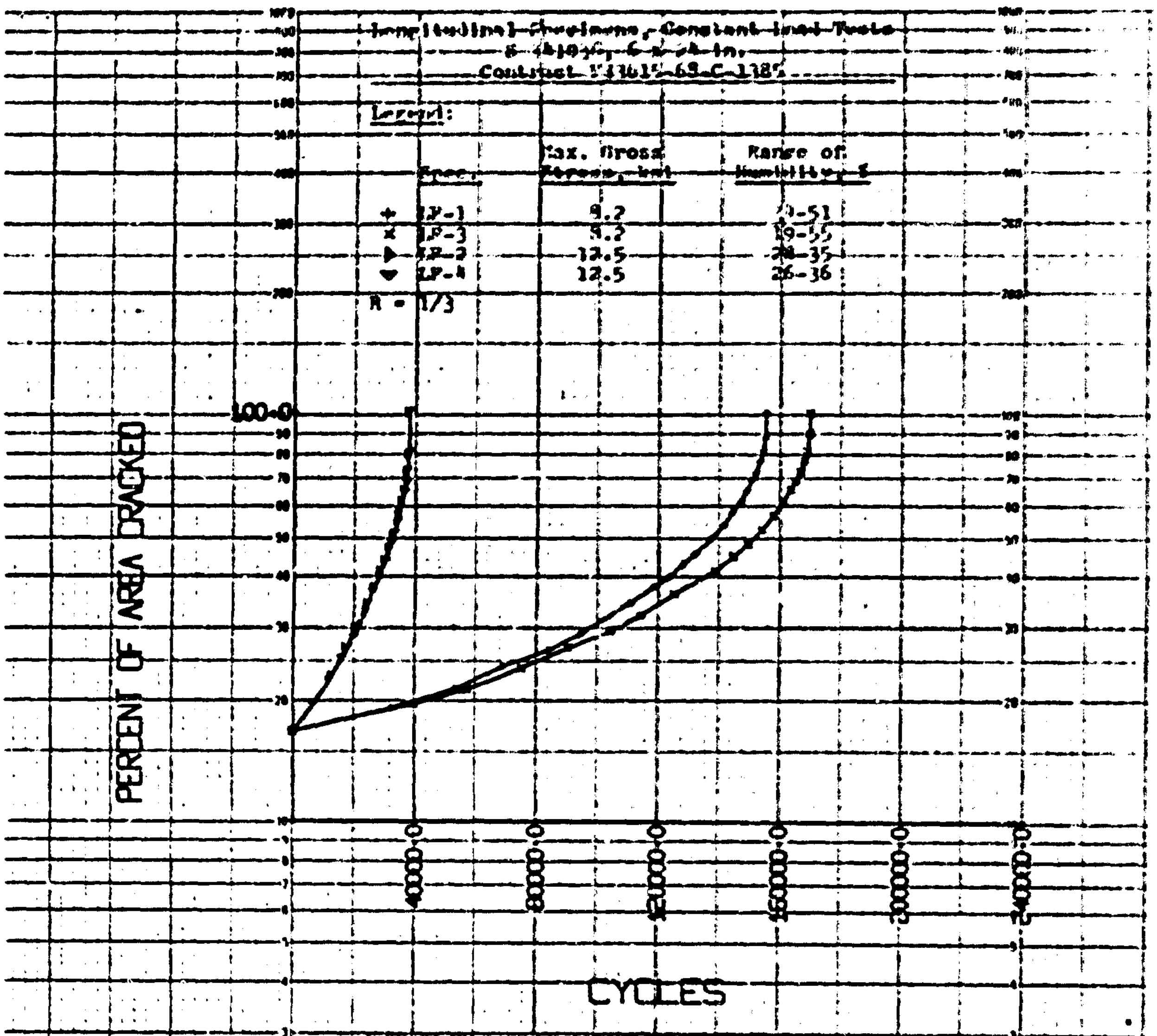

EFFECT OF STRESS LEVEL ON FATIGUE-CRACK PROPAGATION OF LONG-TRANSVERSE SPECIMENS FROM A 7079-T652 FORGING

Fig. 72



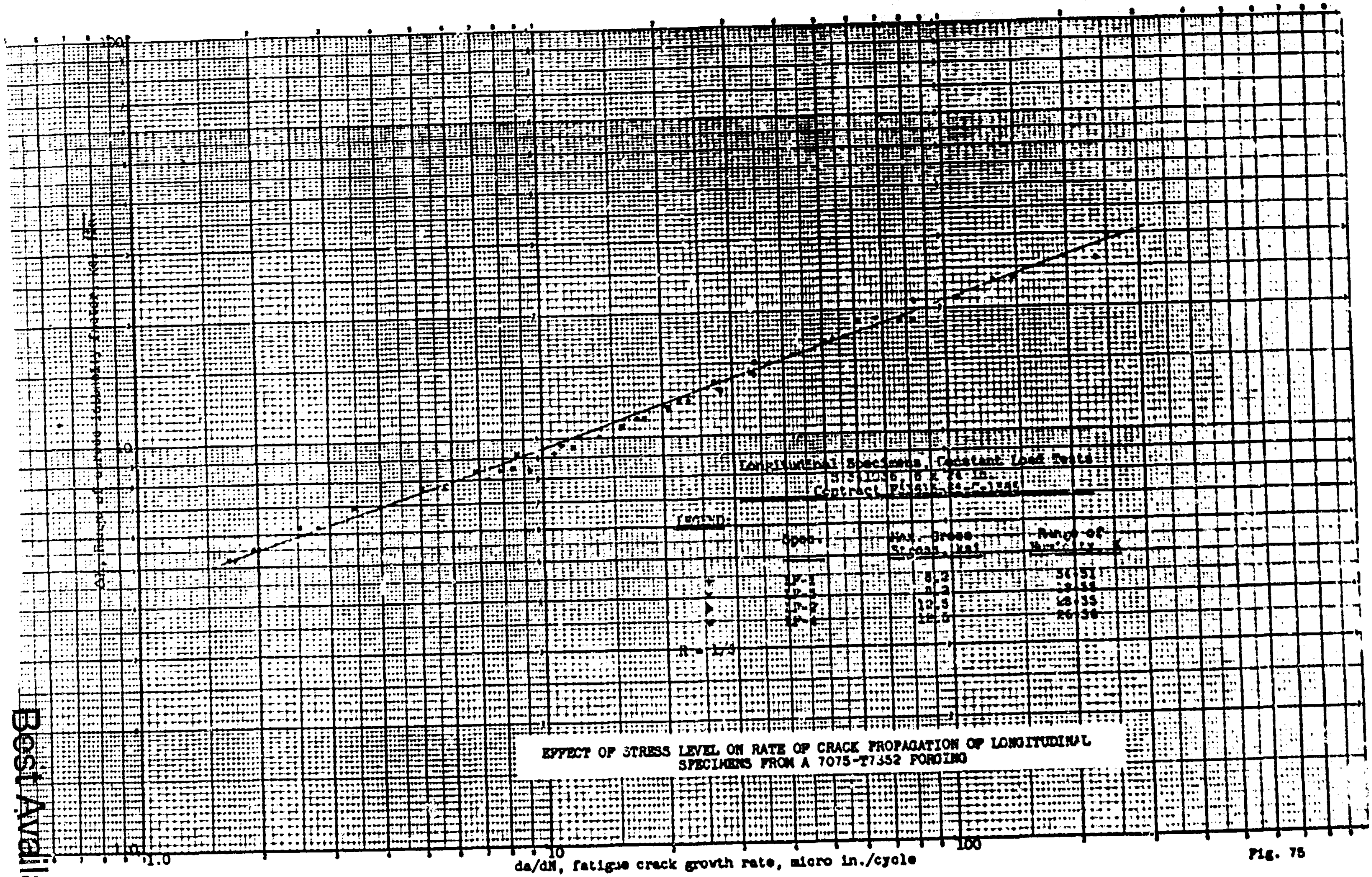

EFFECT OF STRESS LEVEL ON RATE OF CRACK PROPAGATION OF LONG-TRANSVERSE SPECIMENS FROM A 7079-T652 FORGING

Fig. 73



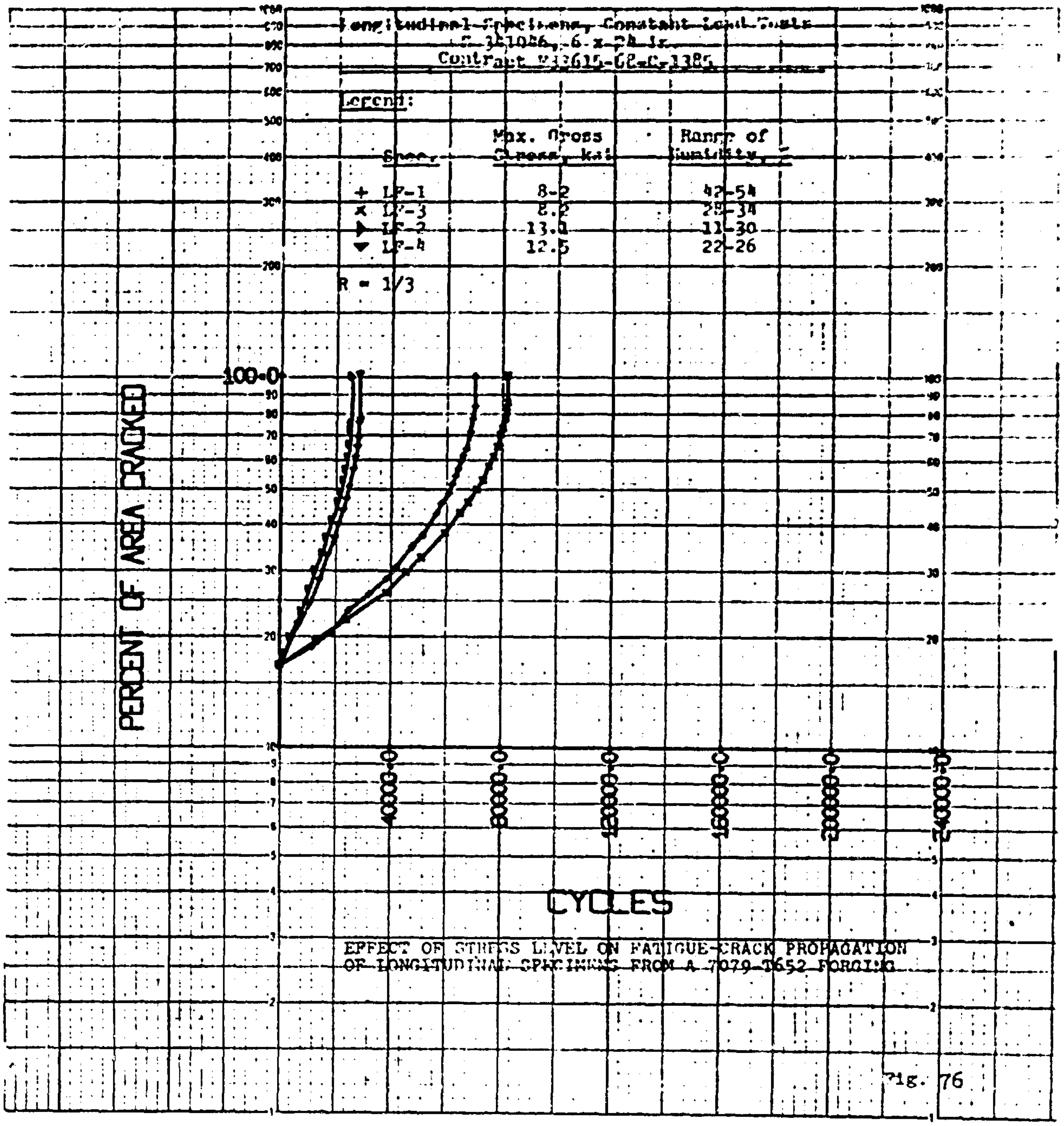

EFFECT OF STRESS LEVEL ON FATIGUE-CRACK PROPAGATION
OF LONGITUDINAL SPECIMENS FROM A 7075-T7352 FORGING

Fig. 74



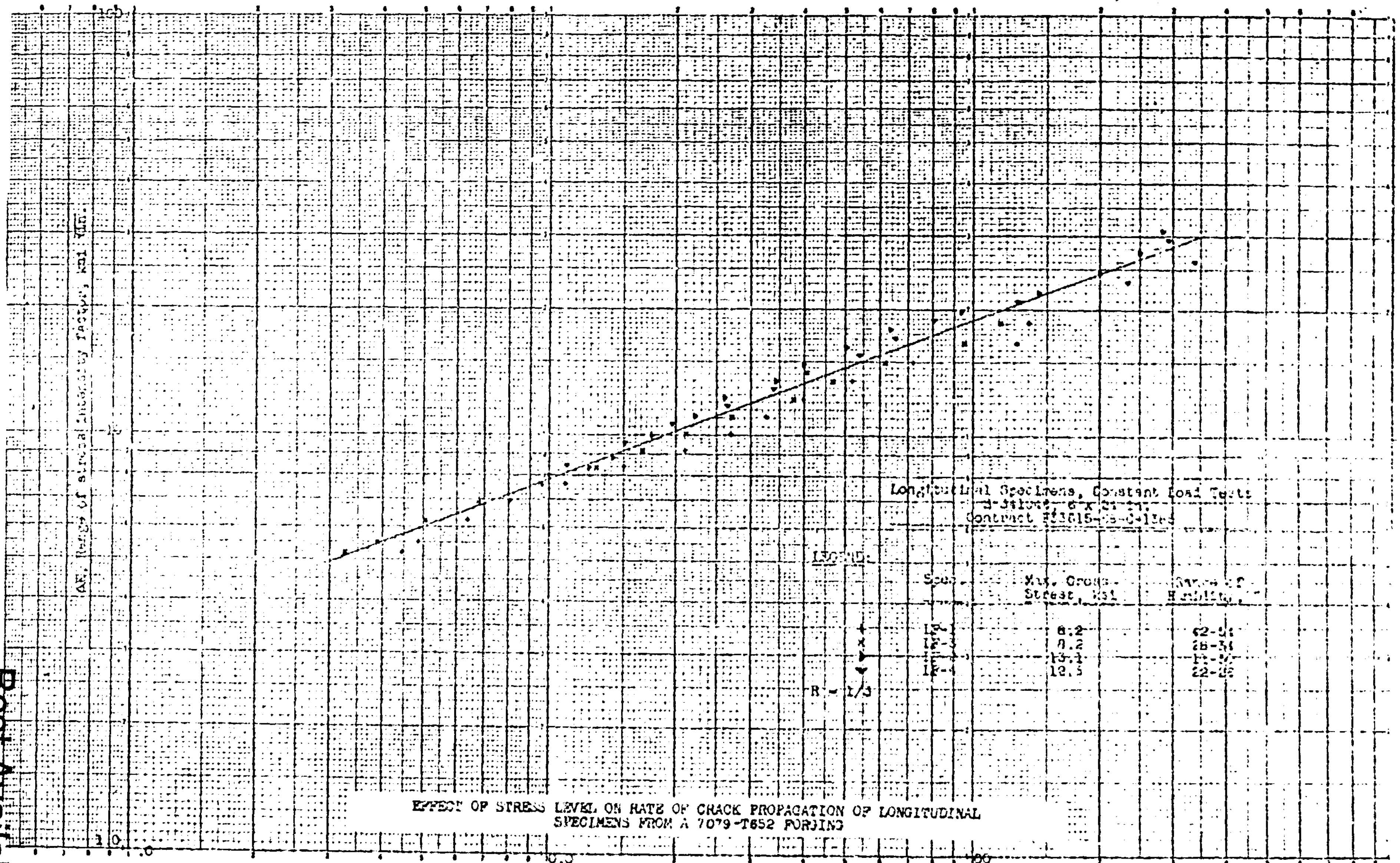

EFFECT OF STRESS LEVEL ON RATE OF CRACK PROPAGATION OF LONGITUDINAL SPECIMENS FROM A 7075-T7352 FORGING

Fig. 75



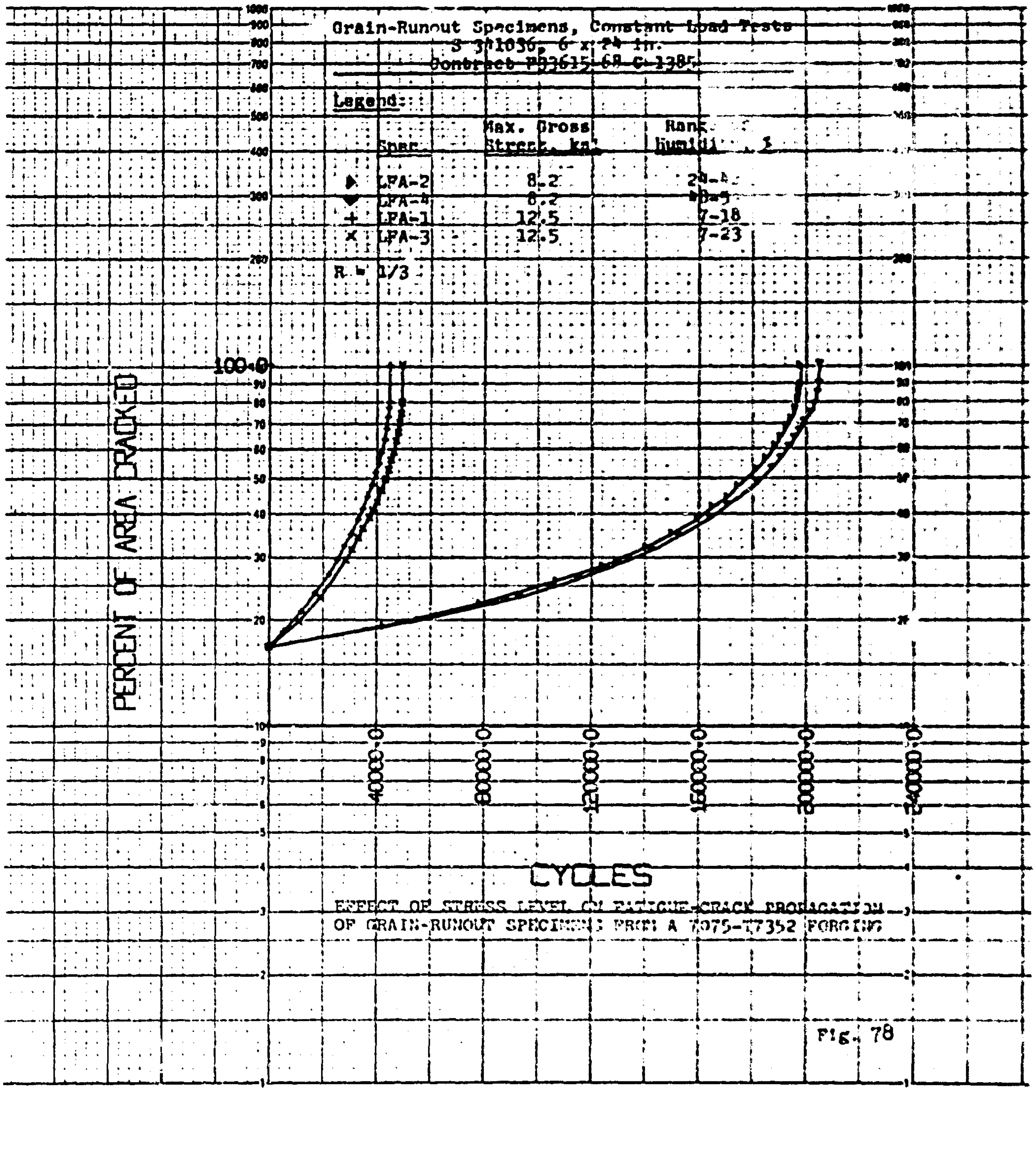

EFFECT OF STRESS LEVEL ON FATIGUE-CRACK PROPAGATION OF LONGITUDINAL SPECIMENS FROM A 7079-T652 FORGING

Fig. 76




EFFECT OF STRESS LEVEL ON RATE OF CRACK PROPAGATION OF LONGITUDINAL SPECIMENS FROM A 7079-T652 FORGING

Fig. 77




EFFECT OF STRESS LEVEL ON FATIGUE-CRACK PROPAGATION OF GRAIN-RUNOUT SPECIMENS FROM A 7075-T7352 FORGING

Fig. 78

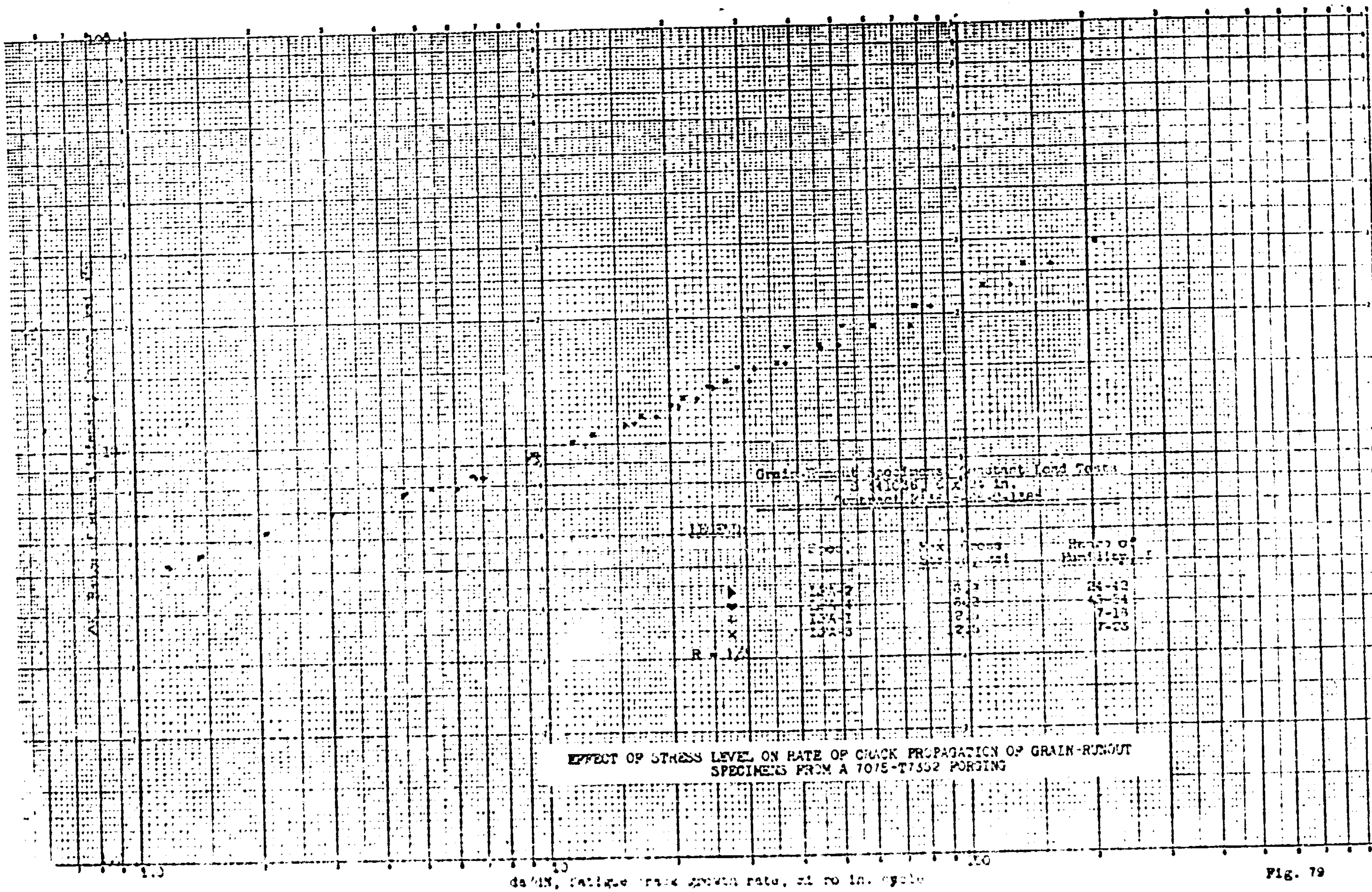
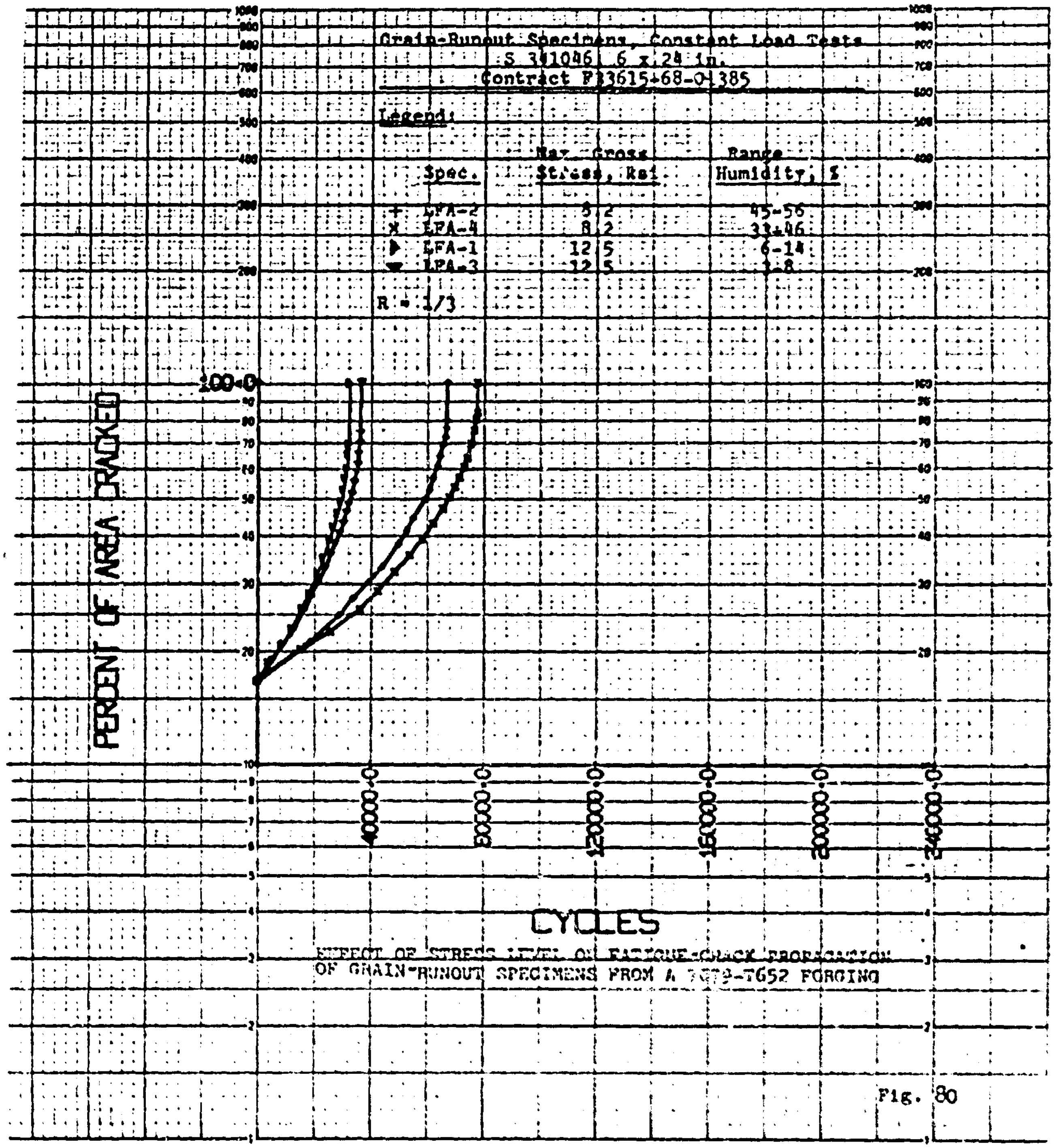

EFFECT OF STRESS LEVEL ON RATE OF CRACK PROPAGATION OF GRAIN-RUNOUT SPECIMENS FROM A 7075-T7352 FORGING
R = 1/2
da/dN, fatigue crack growth rate, µi to in. cycle

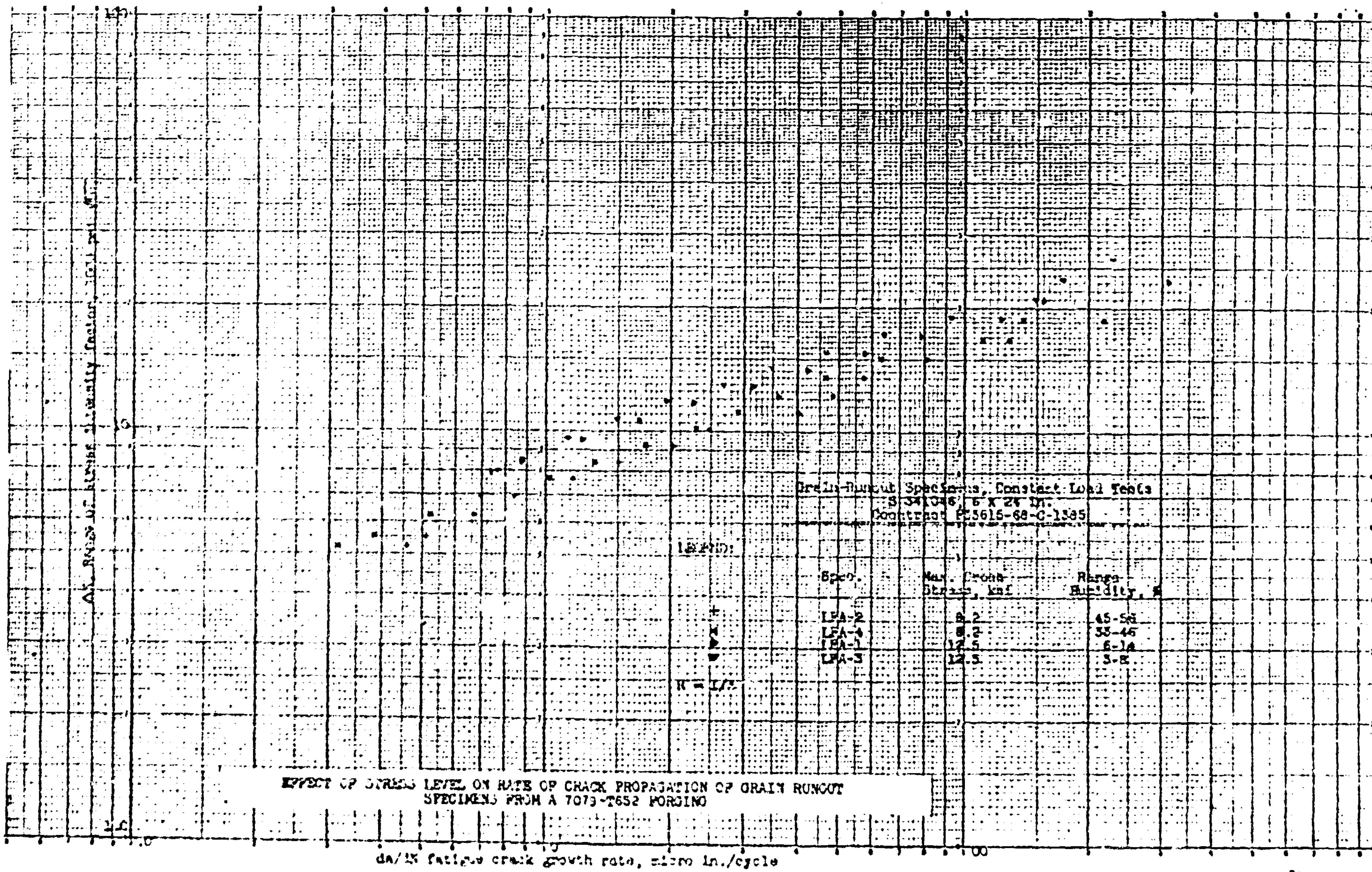
Fig. 79




EFFECT OF STRESS LEVEL ON FATIGUE-CRACK PROPAGATION OF GRAIN-RUNOUT SPECIMENS FROM A 7079-T652 FORGING

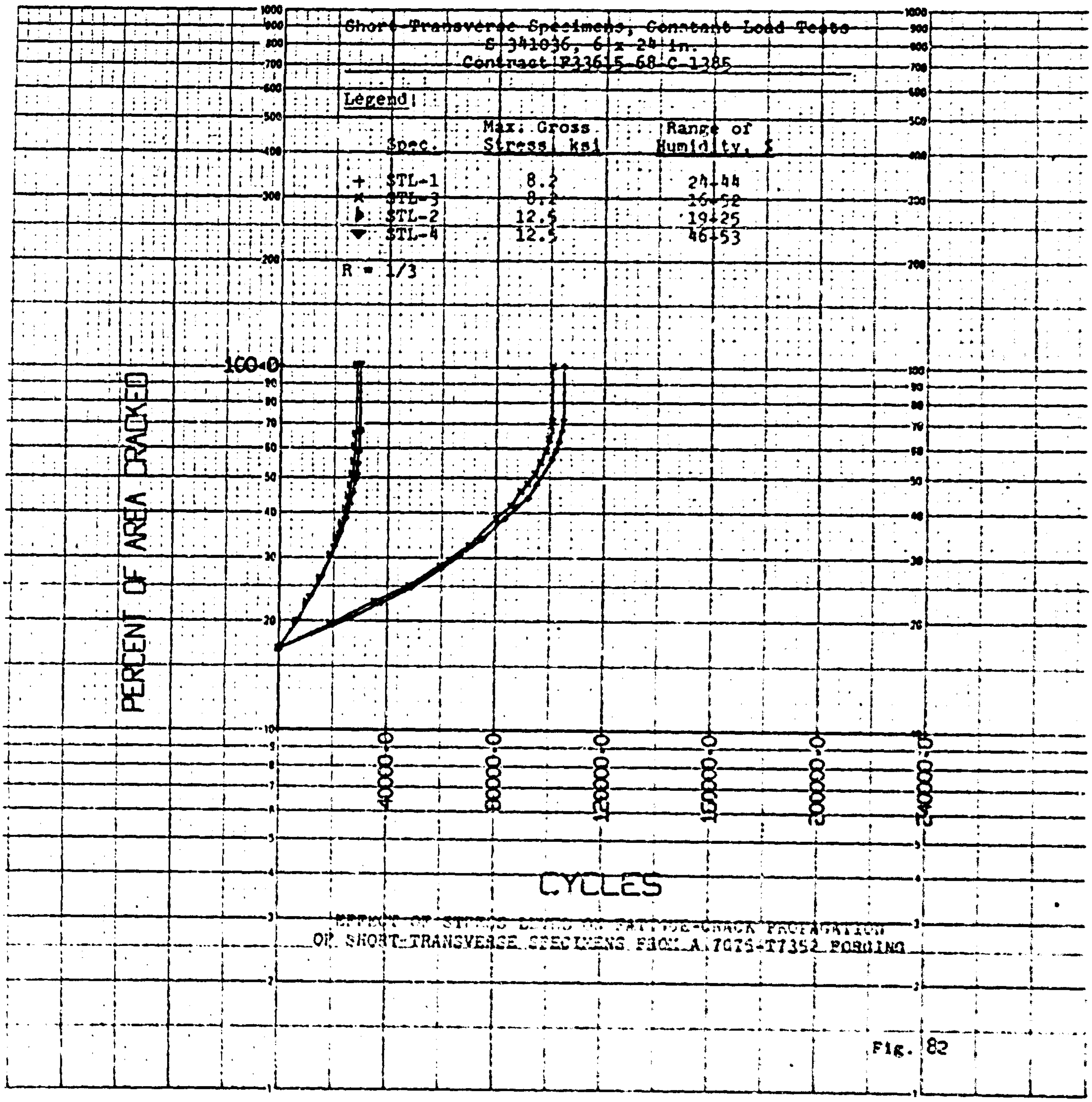
Fig. 80

Best Available Copy




EFFECT OF STRESS LEVEL ON RATE OF CRACK PROPAGATION OF GRAIN RUNOUT SPECIMENS FROM A 7079-T652 FORGING

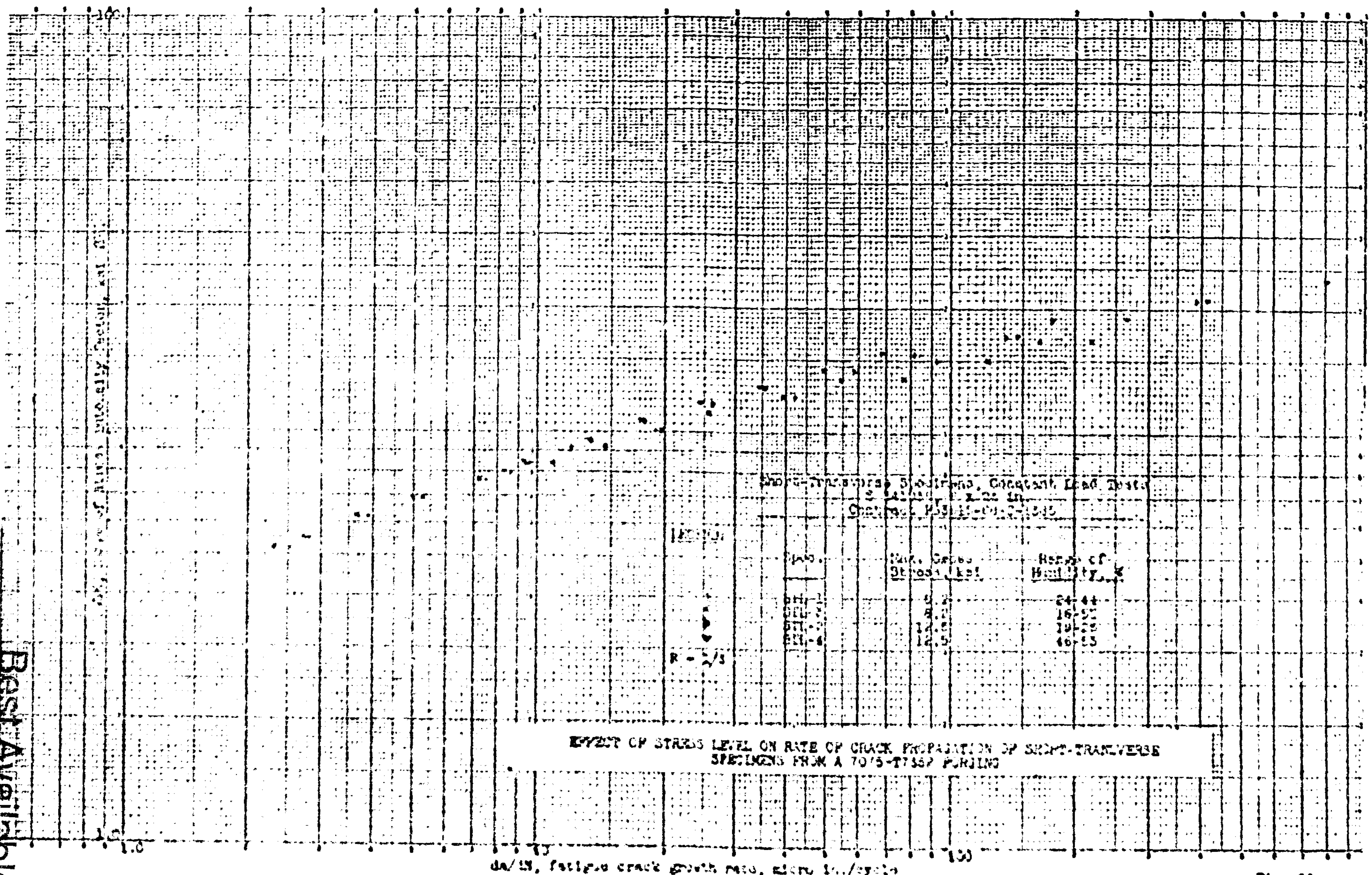
Fig. 81




EFFECT OF STRESS LEVEL ON FATIGUE-CRACK PROPAGATION OF SHORT-TRANSVERSE SPECIMENS FROM A 7075-T7352 FORGING

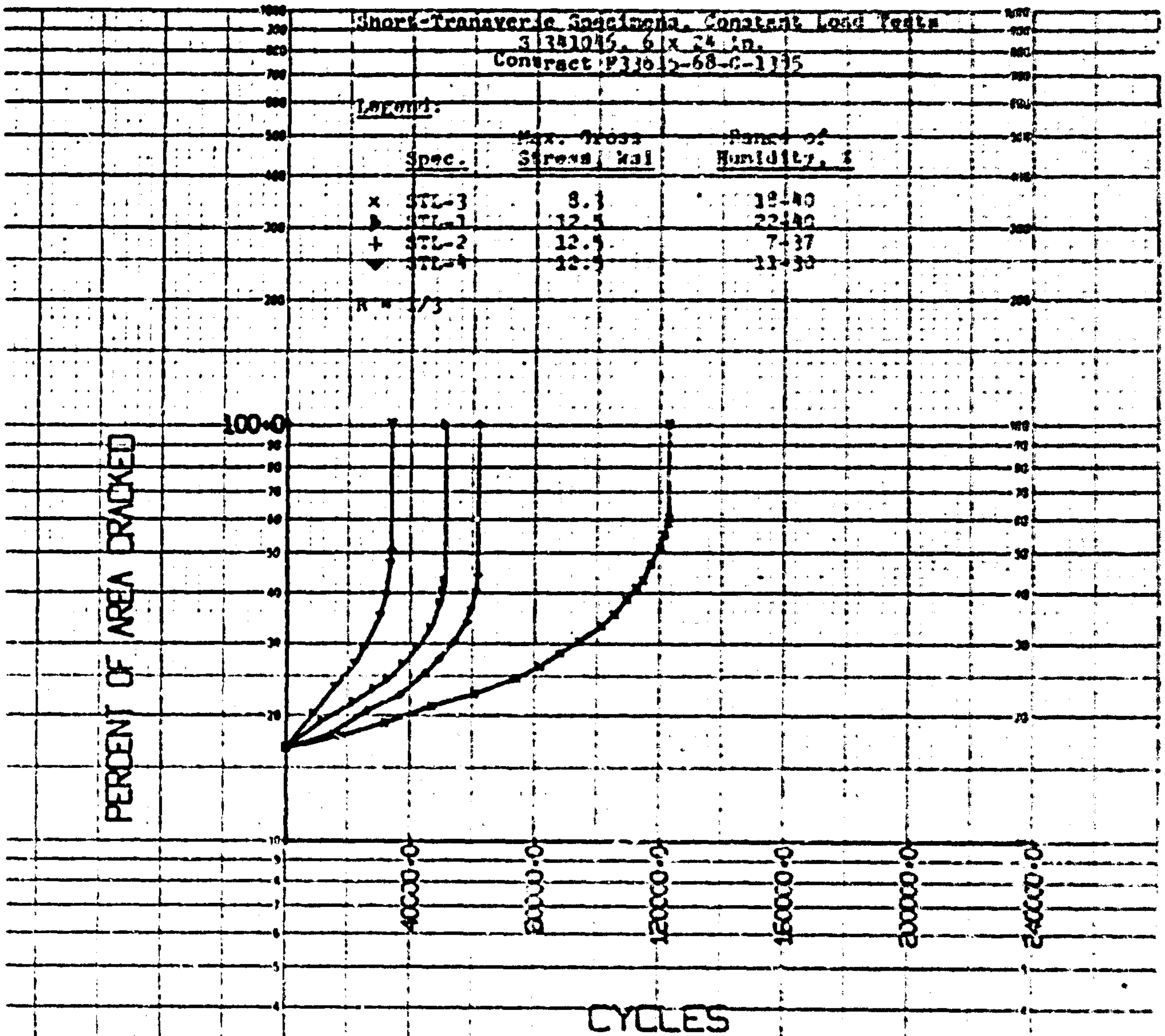
Fig. 82

Best Available Copy




EFFECT OF STRESS LEVEL ON RATE OF CRACK PROPAGATION OF SHORT-TRANSVERSE SPECIMENS FROM A 7075-T7352 FORGING

Fig. 83




EFFECT OF STRESS LEVEL ON FATIGUE-CRACK PROPAGATION
OF SHORT-TRANSVERSE SPECIMENS FROM A 7079-T652 FORGING

Fig. 84

Best Available Copy

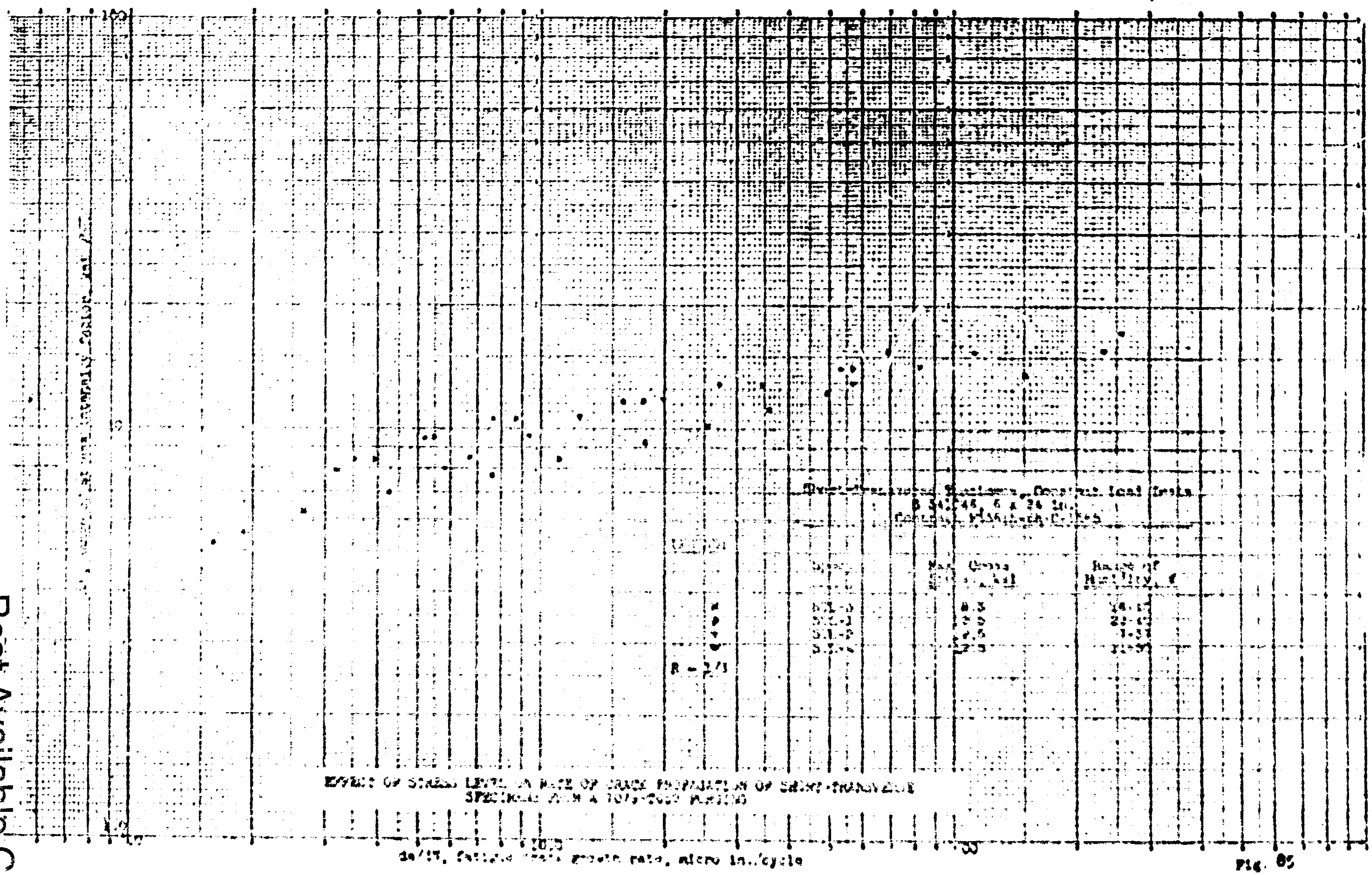
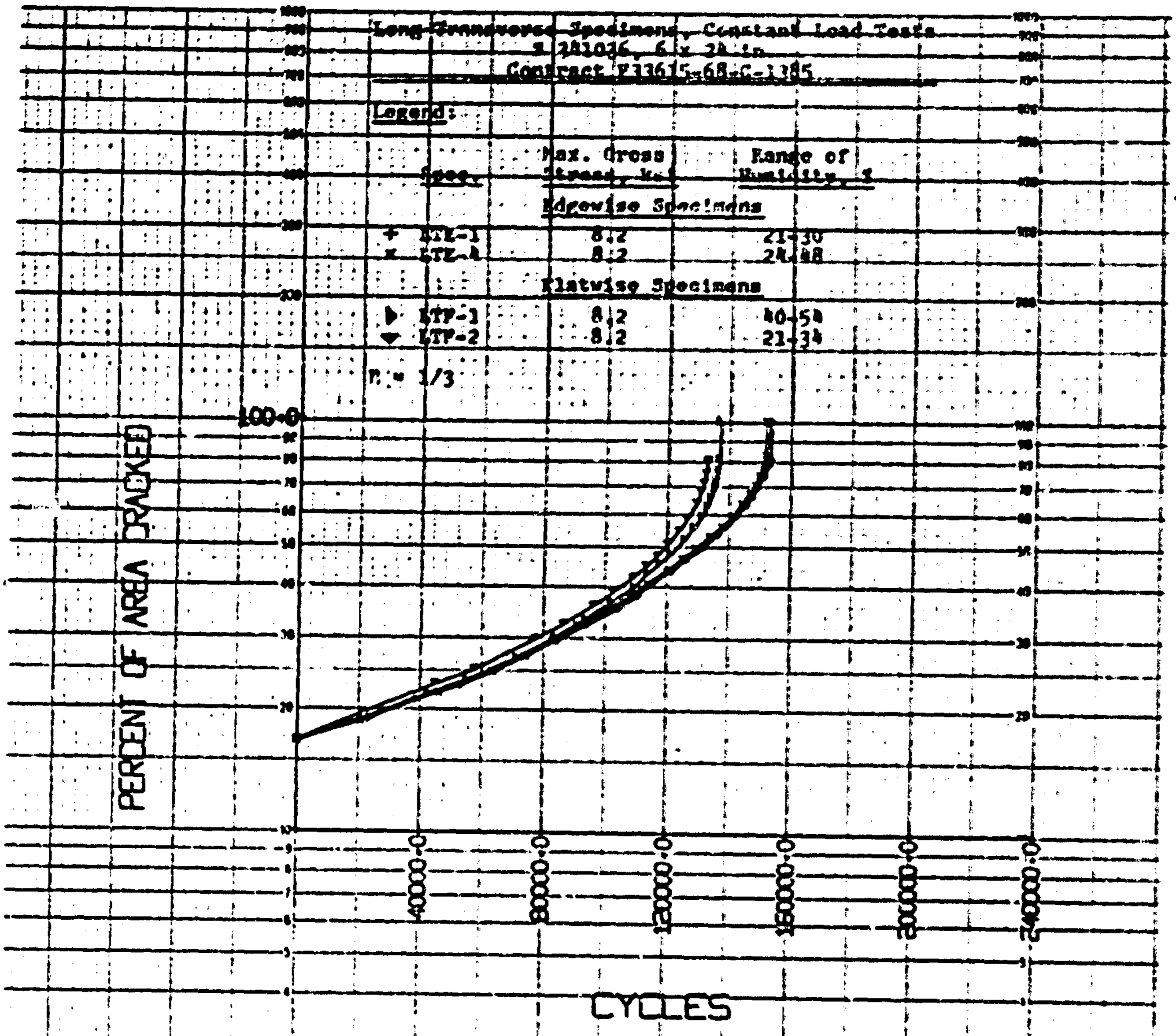
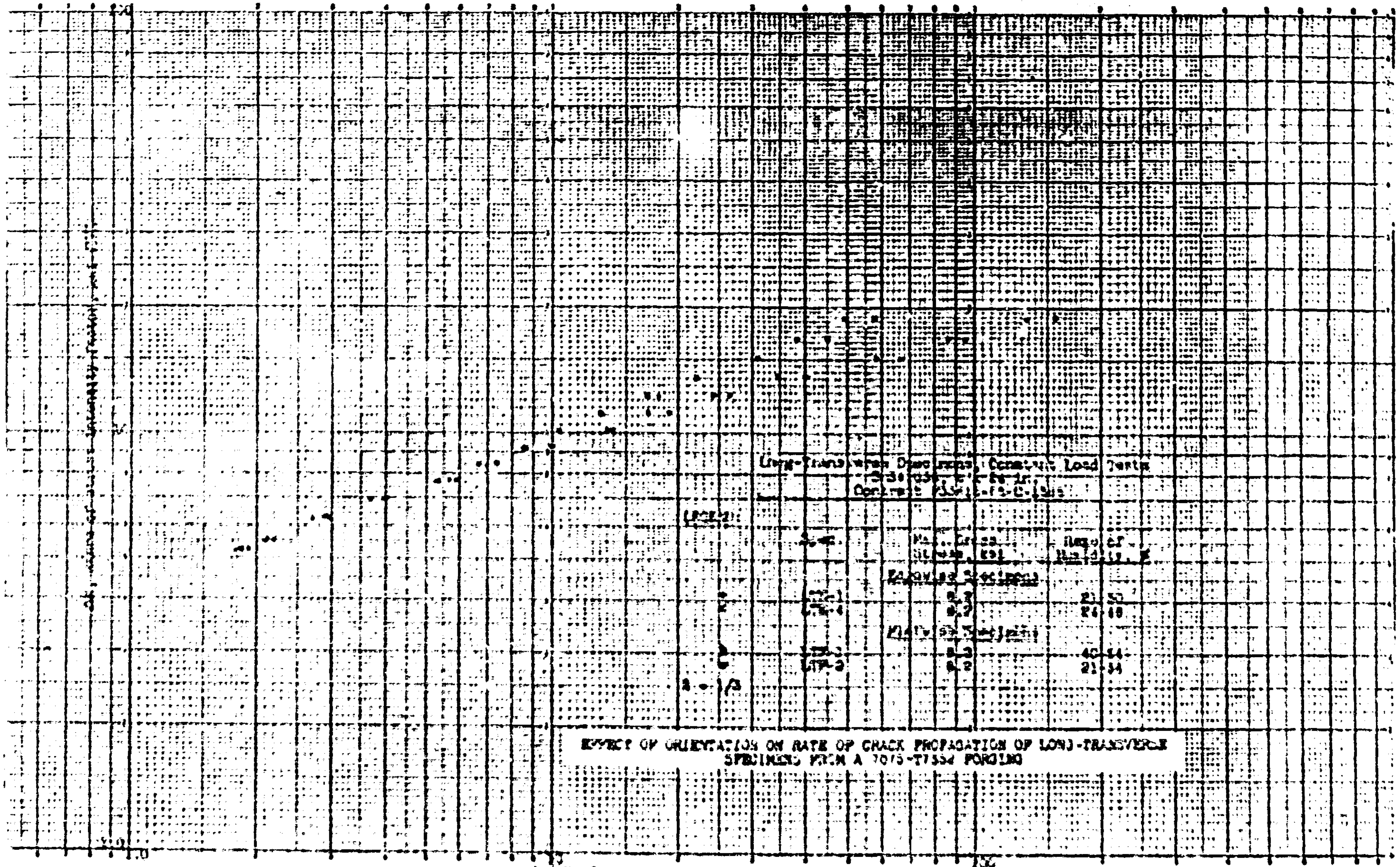



Fig. 85



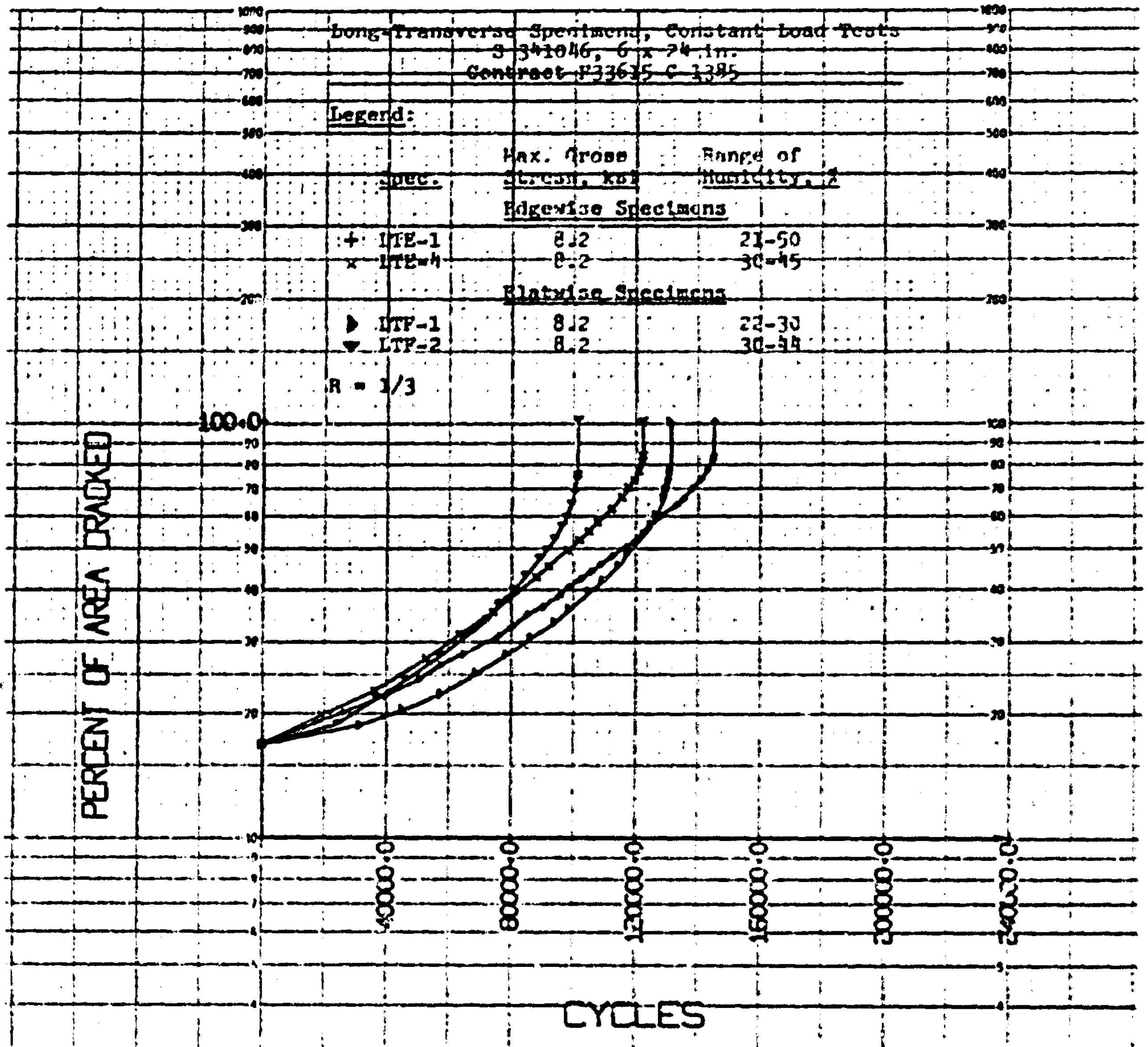

EFFECT OF ORIENTATION ON FATIGUE-CRACK PROPAGATION OF LONG-TRANSVERSE SPECIMENS FROM 7075-T7352 FORGINGS

Fig. 86



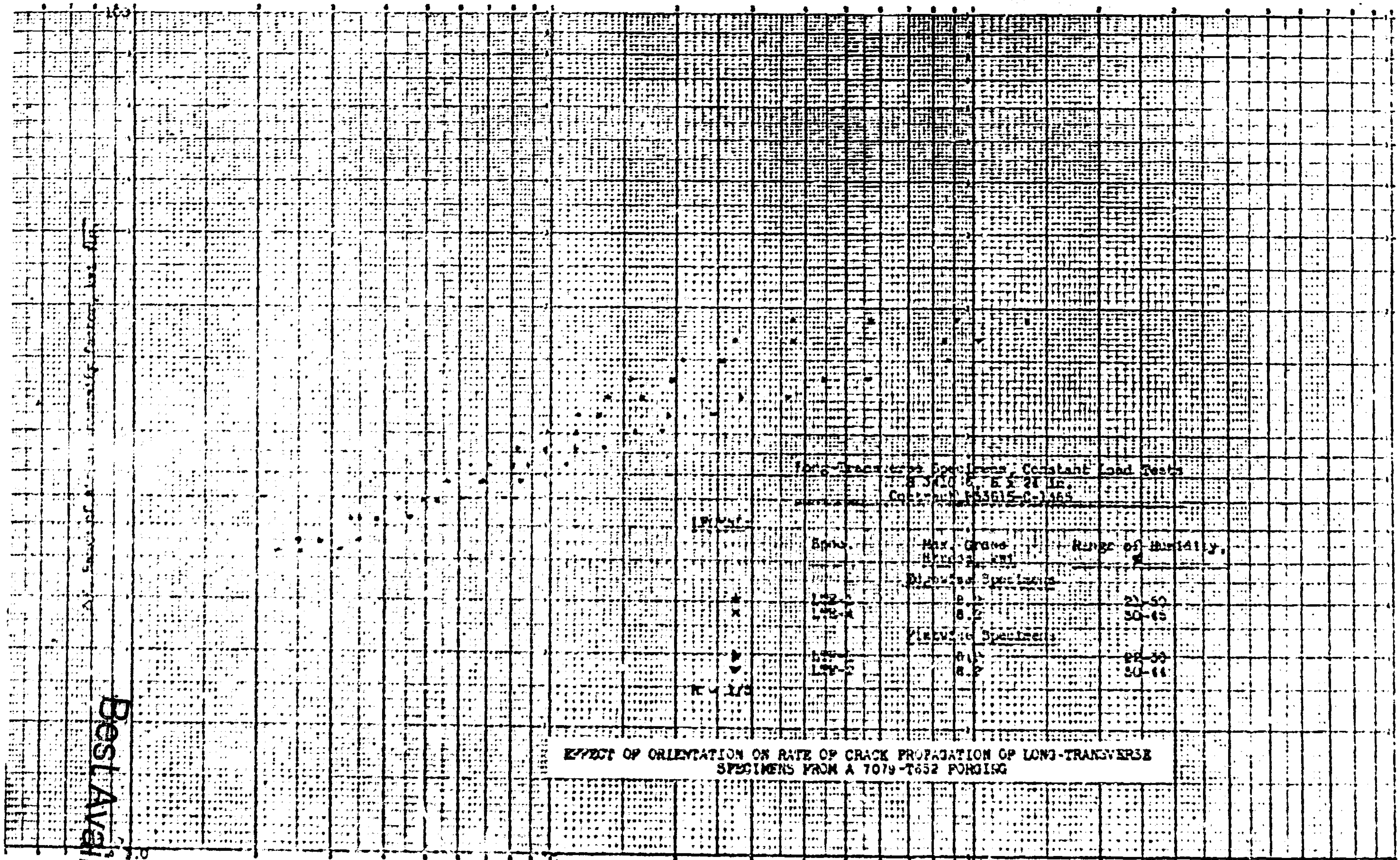

EFFECT OF ORIENTATION ON RATE OF CRACK PROPAGATION OF LONG-TRANSVERSE SPECIMENS FROM A 7075-T7354 FORGING

Fig. 87




OF LONG-TRANSVERSE SPECIMENS FROM 7079-T652 FORGINGS

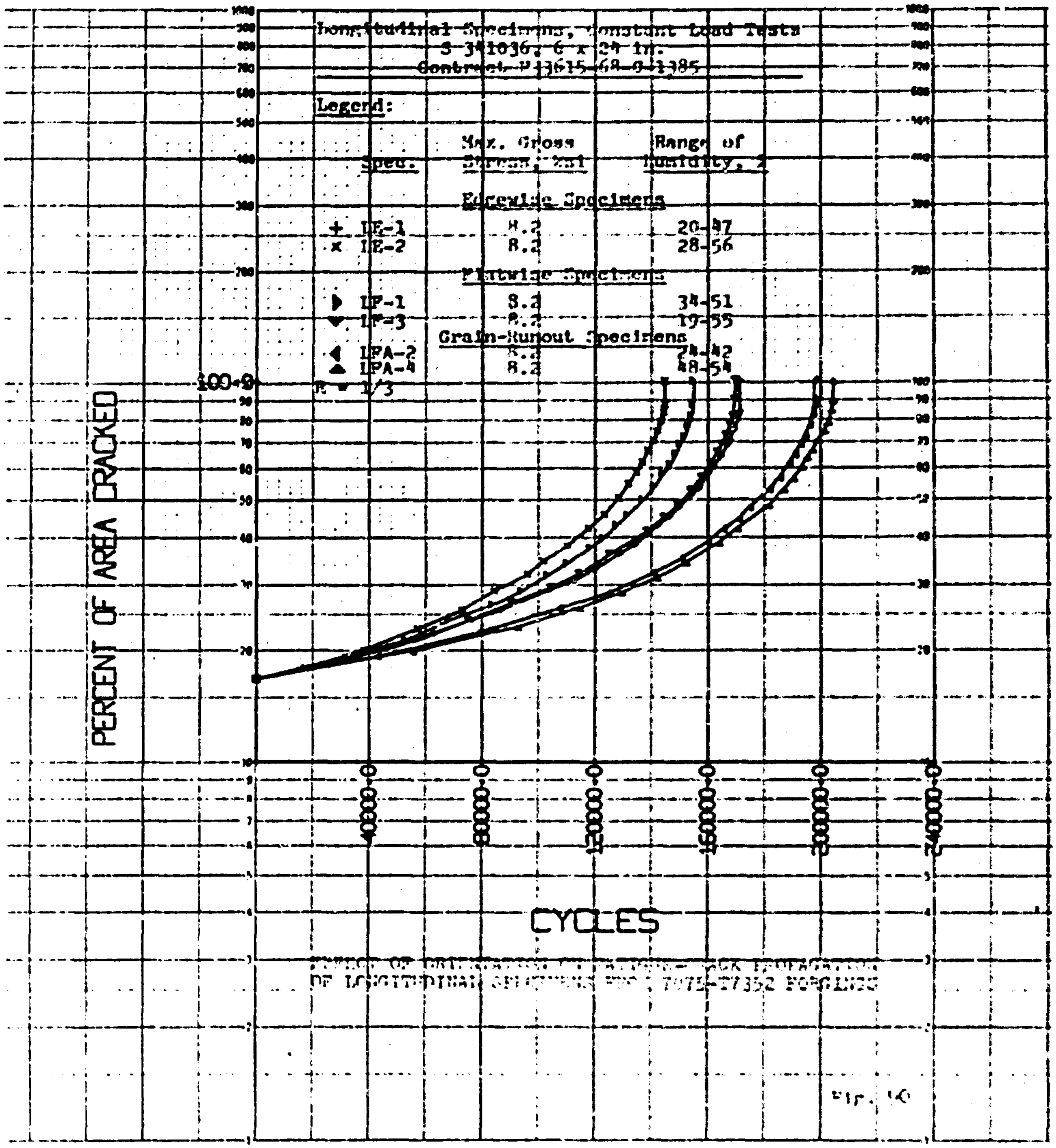
Fig. 88



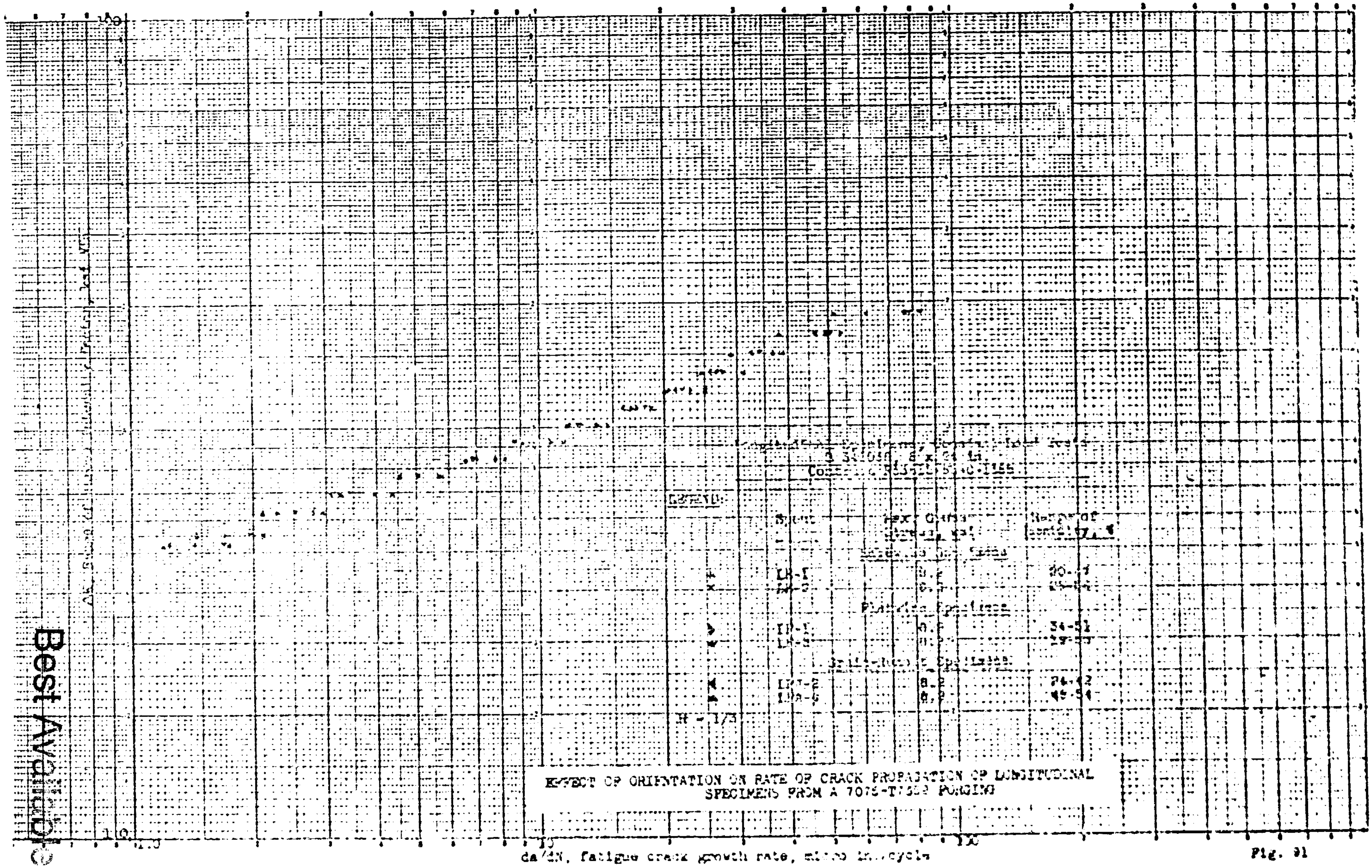

EFFECT OF ORIENTATION ON RATE OF CRACK PROPAGATION OF LONG-TRANSVERSE SPECIMENS FROM A 7079-T652 FORGING

da/dN, fatigue crack growth rate, micro in./cycle

Fig. 99

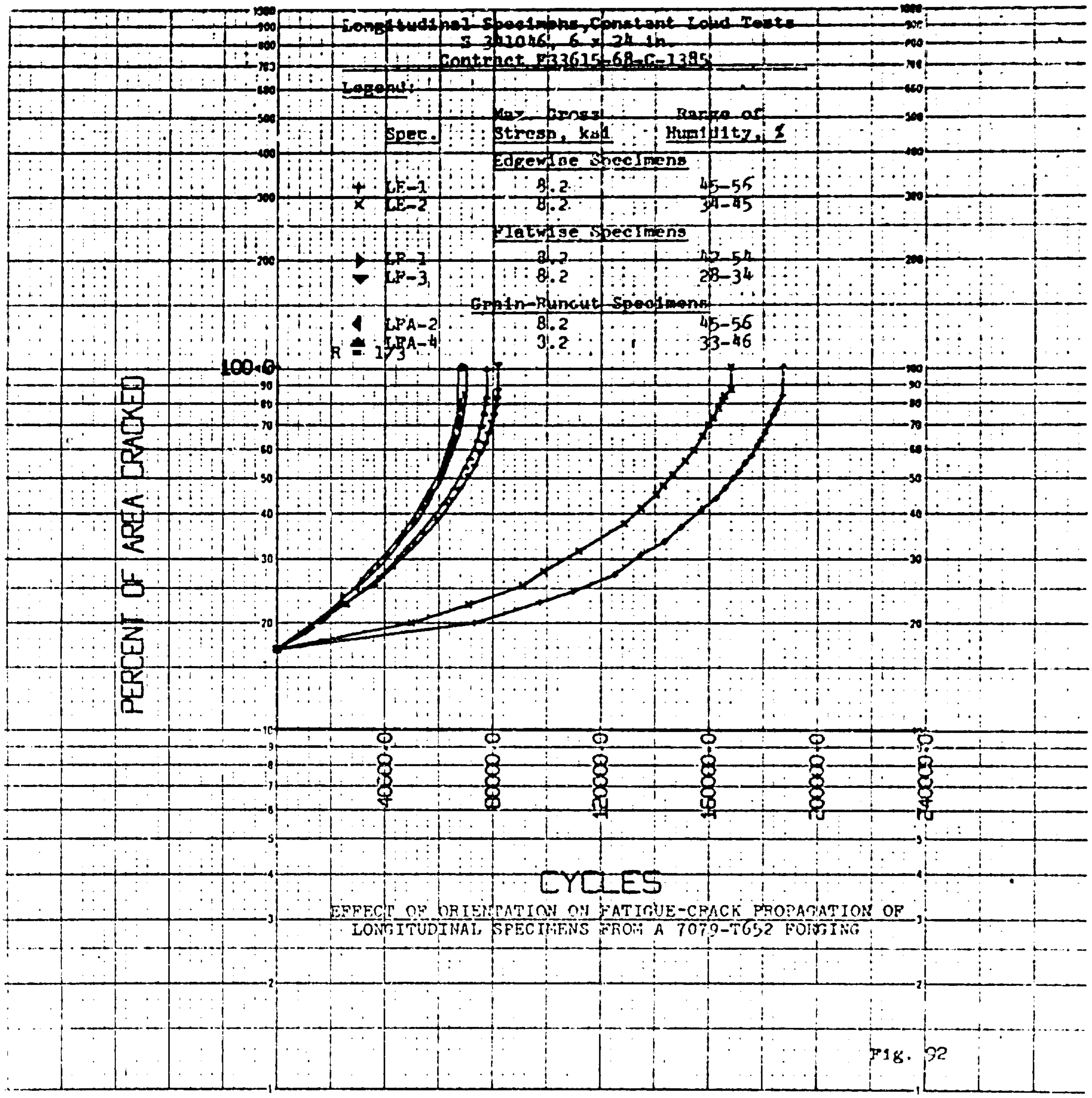



Best Available Copy



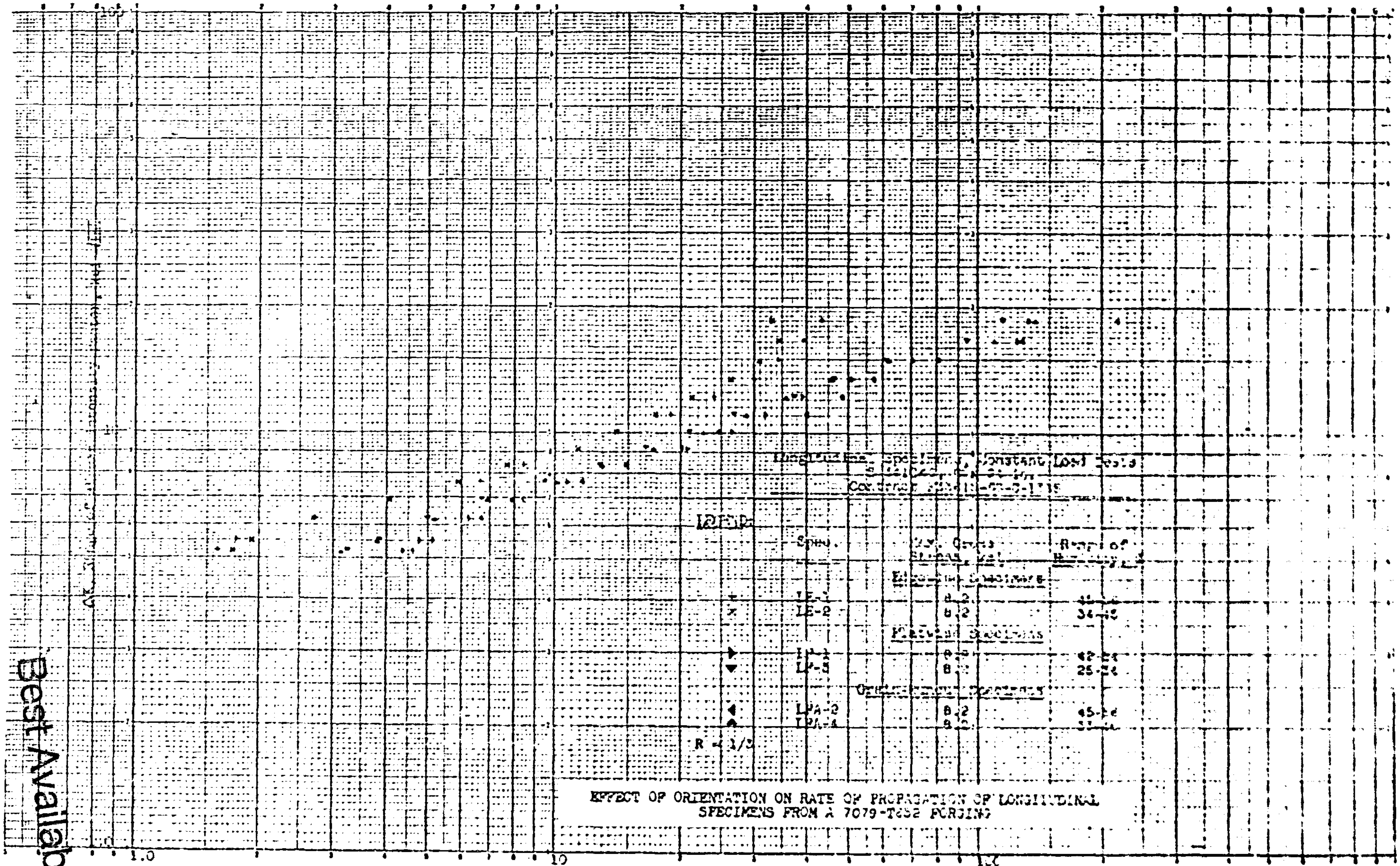

EFFECT OF ORIENTATION ON RATE OF CRACK PROPAGATION OF LONGITUDINAL SPECIMENS FROM A 7075-T7352 FORGING

Fig. 31




EFFECT OF ORIENTATION ON FATIGUE-CRACK PROPAGATION OF LONGITUDINAL SPECIMENS FROM A 7079-T652 FORGING

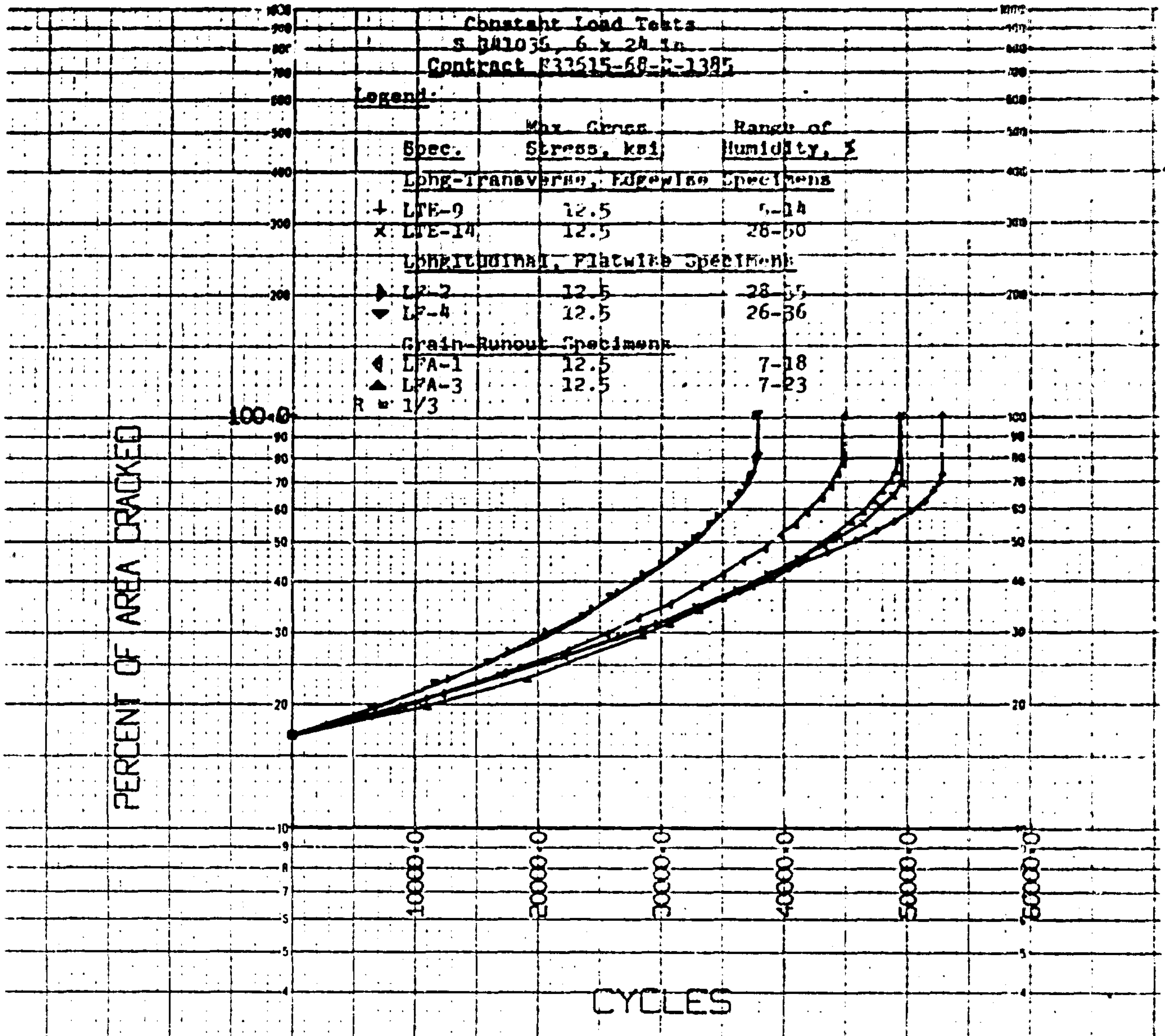
Fig. 92




EFFECT OF ORIENTATION ON RATE OF PROPAGATION OF LONGITUDINAL SPECIMENS FROM A 7079-T652 FORGING

da/dN, fatigue crack growth rate, micro in./cycle

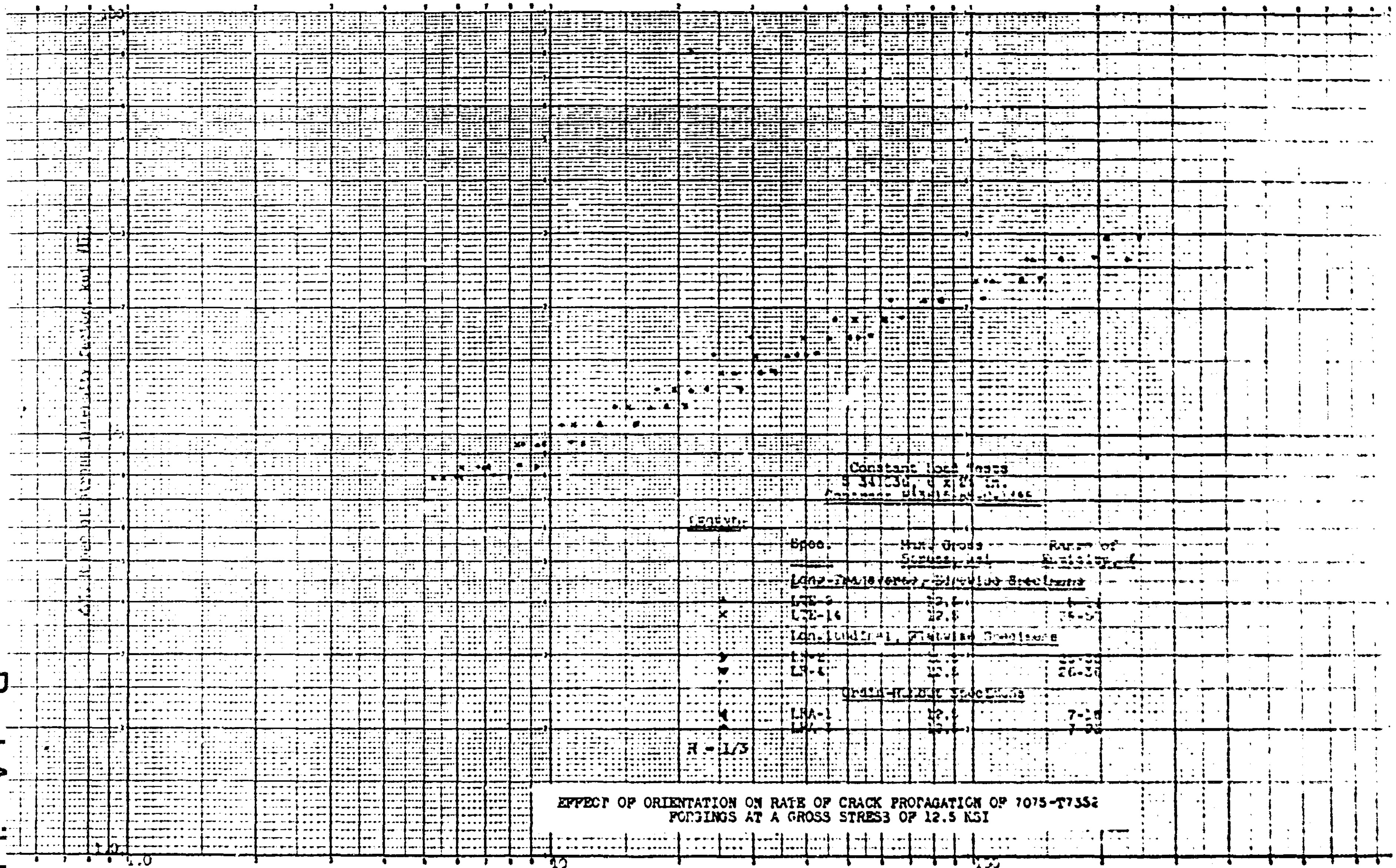
Fig. 33




EFFECT OF ORIENTATION ON FATIGUE-CRACK PROPAGATION OF 7075-T7352 FORGINGS AT A GROSS STRESS OF 12.5 KSI

Fig. 94

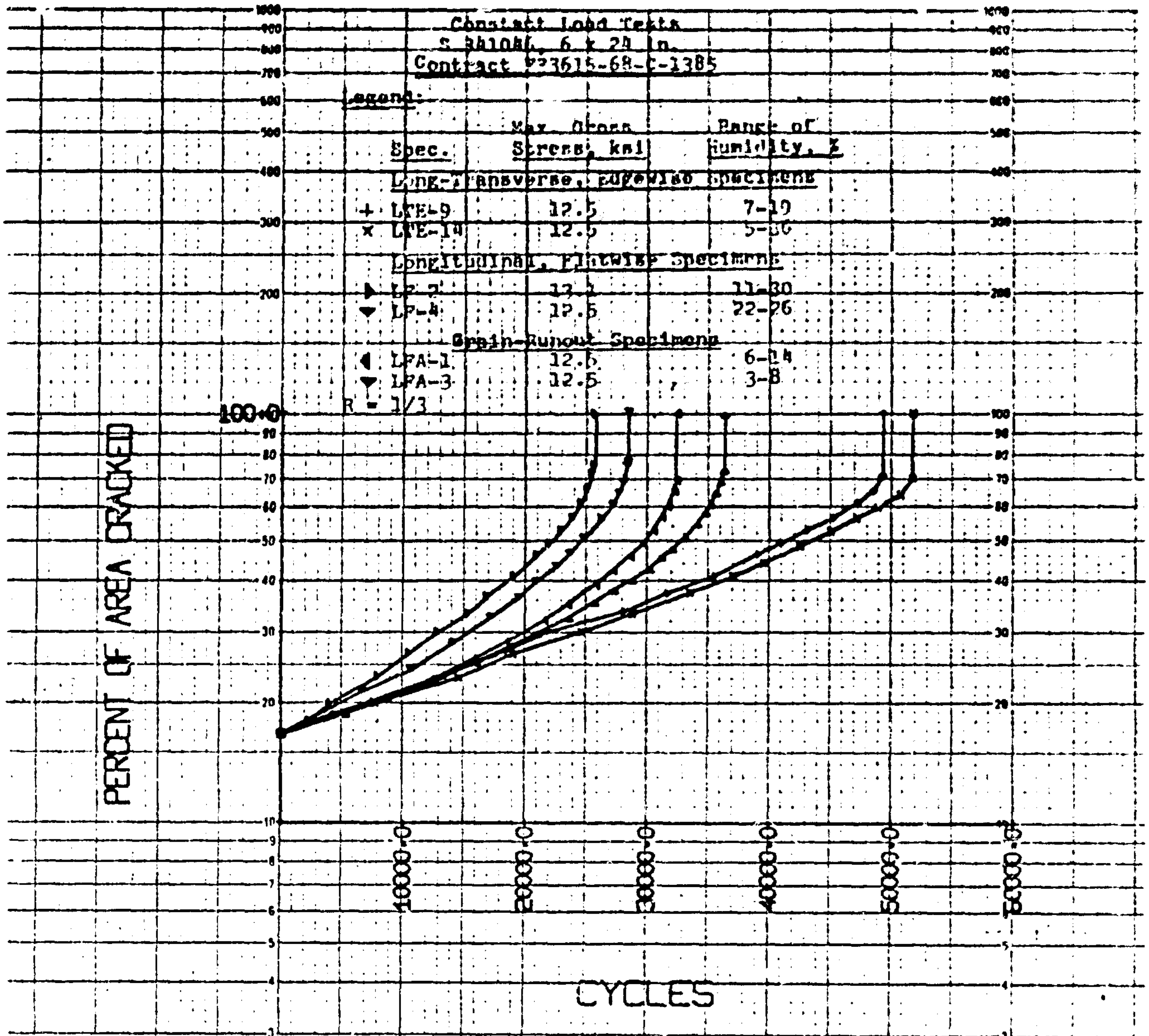
Best Available Copy




EFFECT OF ORIENTATION ON RATE OF CRACK PROPAGATION OF 7075-T7352 FORGINGS AT A GROSS STRESS OF 12.5 KSI

da/dN, fatigue crack growth rate, micro in./cycle

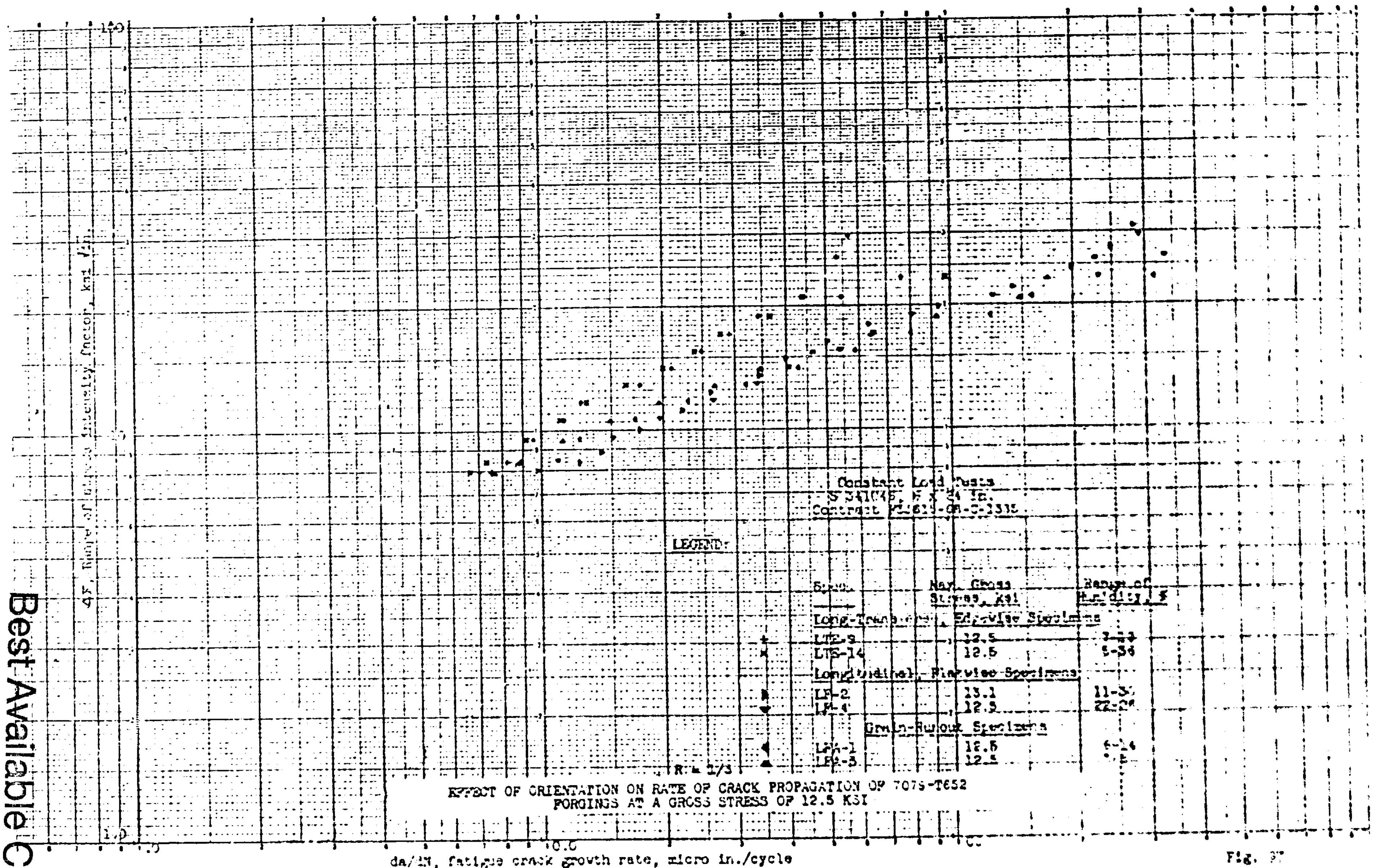
Fig. 5?




EFFECT OF ORIENTATION ON FATIGUE-CRACK PROPAGATION OF 7079-T652 FORGINGS AT A GROSS STRESS OF 12.5 KSI

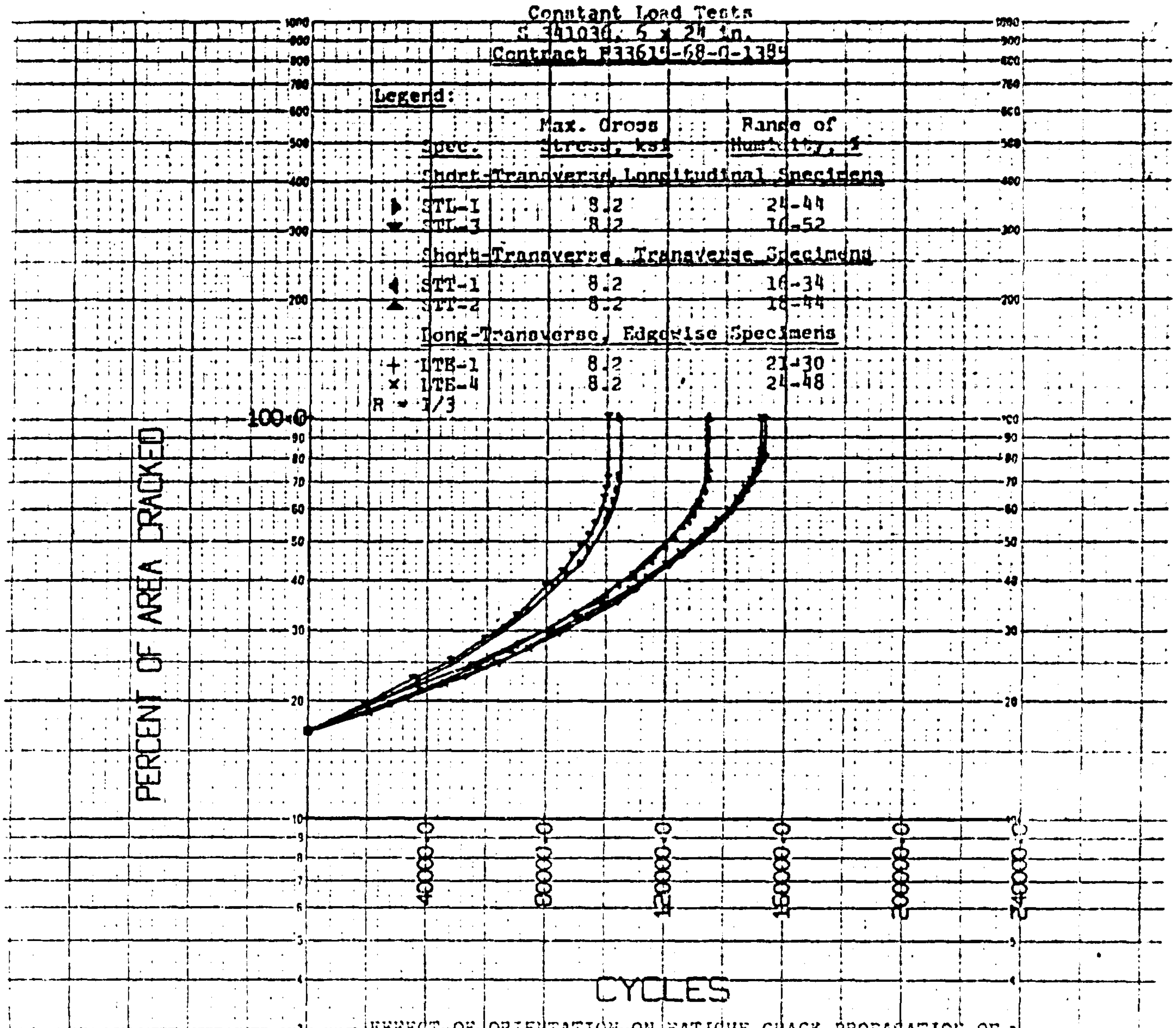
Fig. 96

Best Available Copy




EFFECT OF ORIENTATION ON RATE OF CRACK PROPAGATION OF 7075-T652
FORGINGS AT A GROSS STRESS OF 12.5 KSI

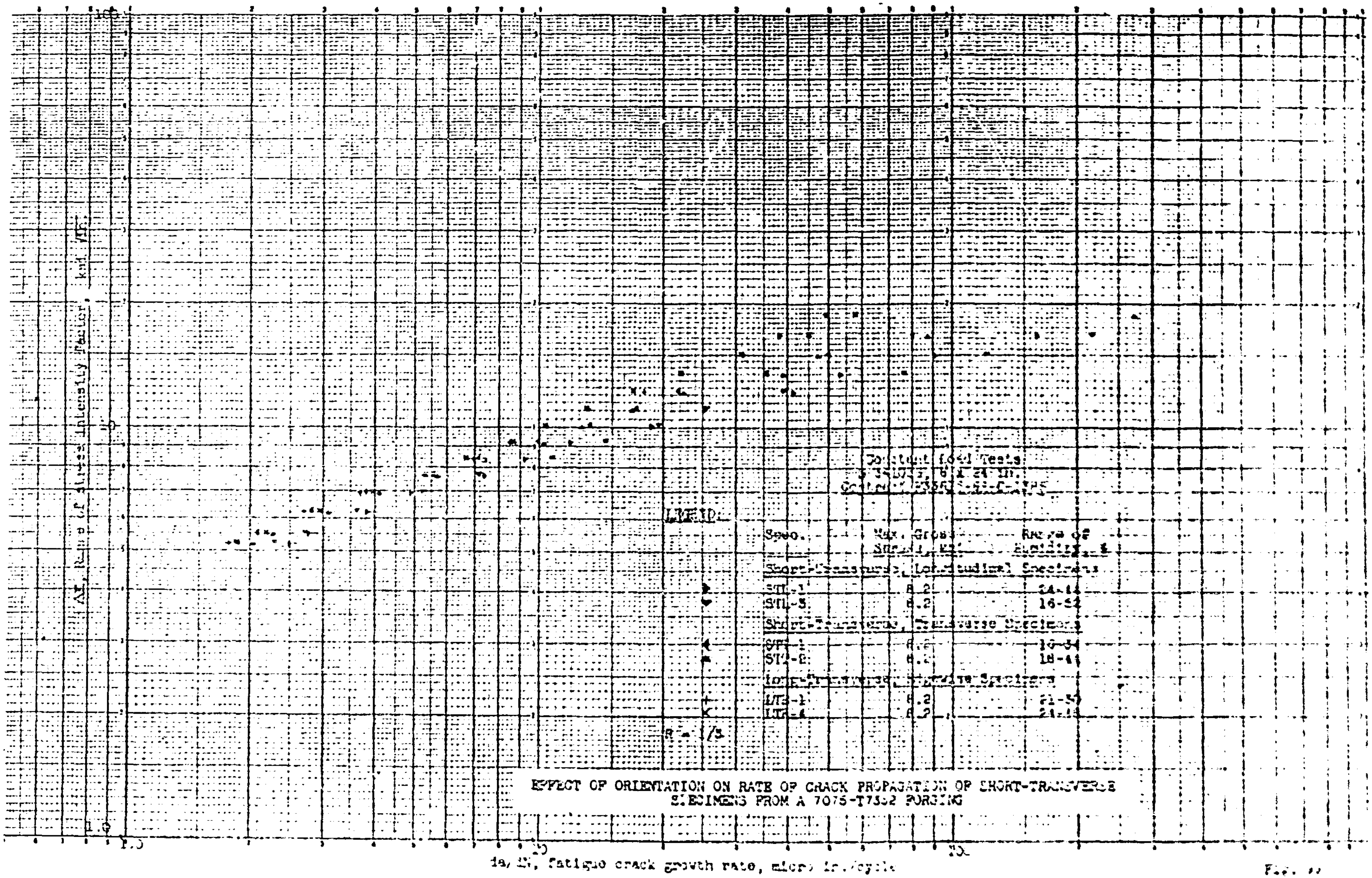
Fig. 37



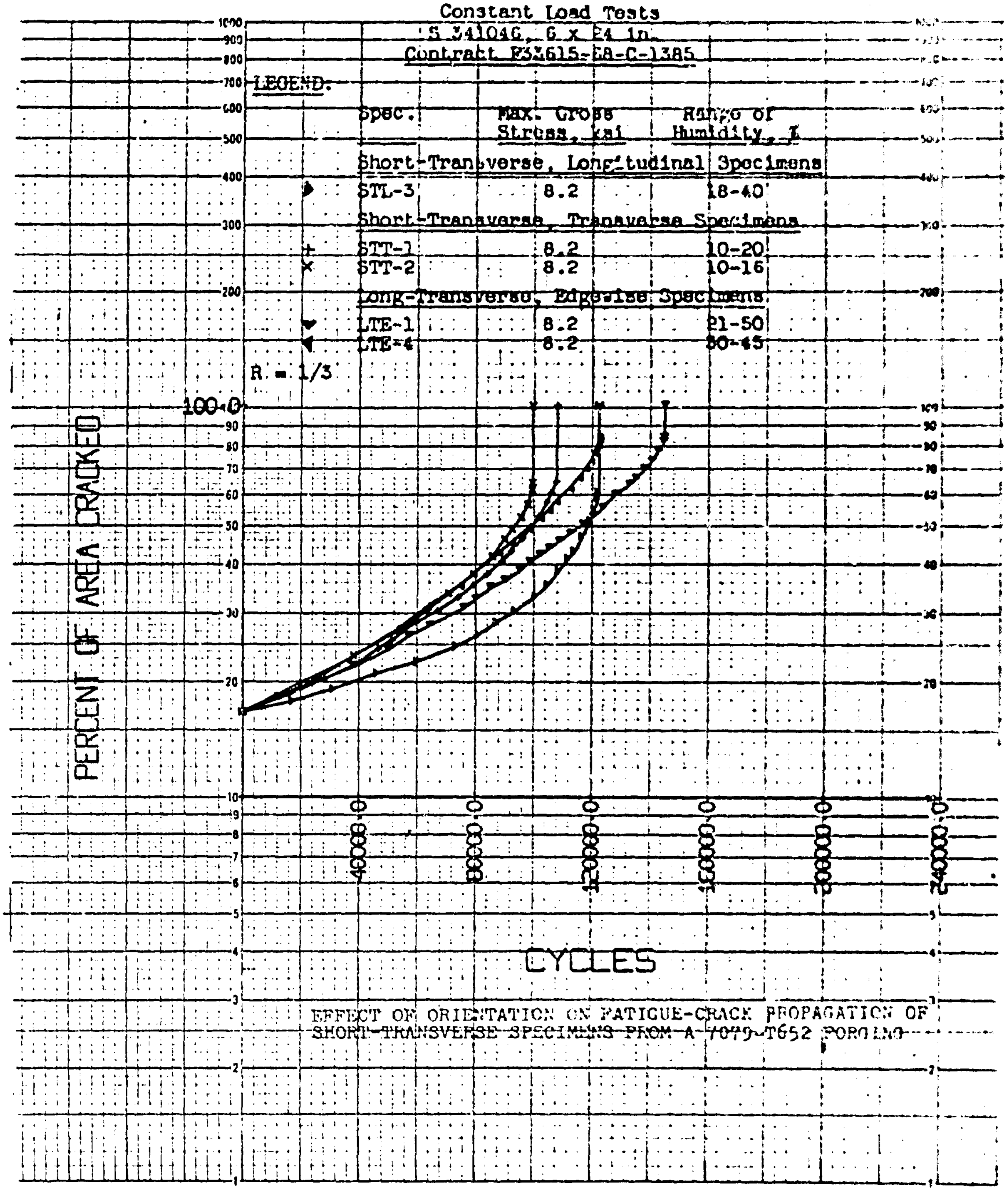

EFFECT OF ORIENTATION ON FATIGUE CRACK PROPAGATION OF SHORT-TRANSVERSE SPECIMENS FROM A 7075-T7352 FORGING

Fig. 98

Best Available Copy



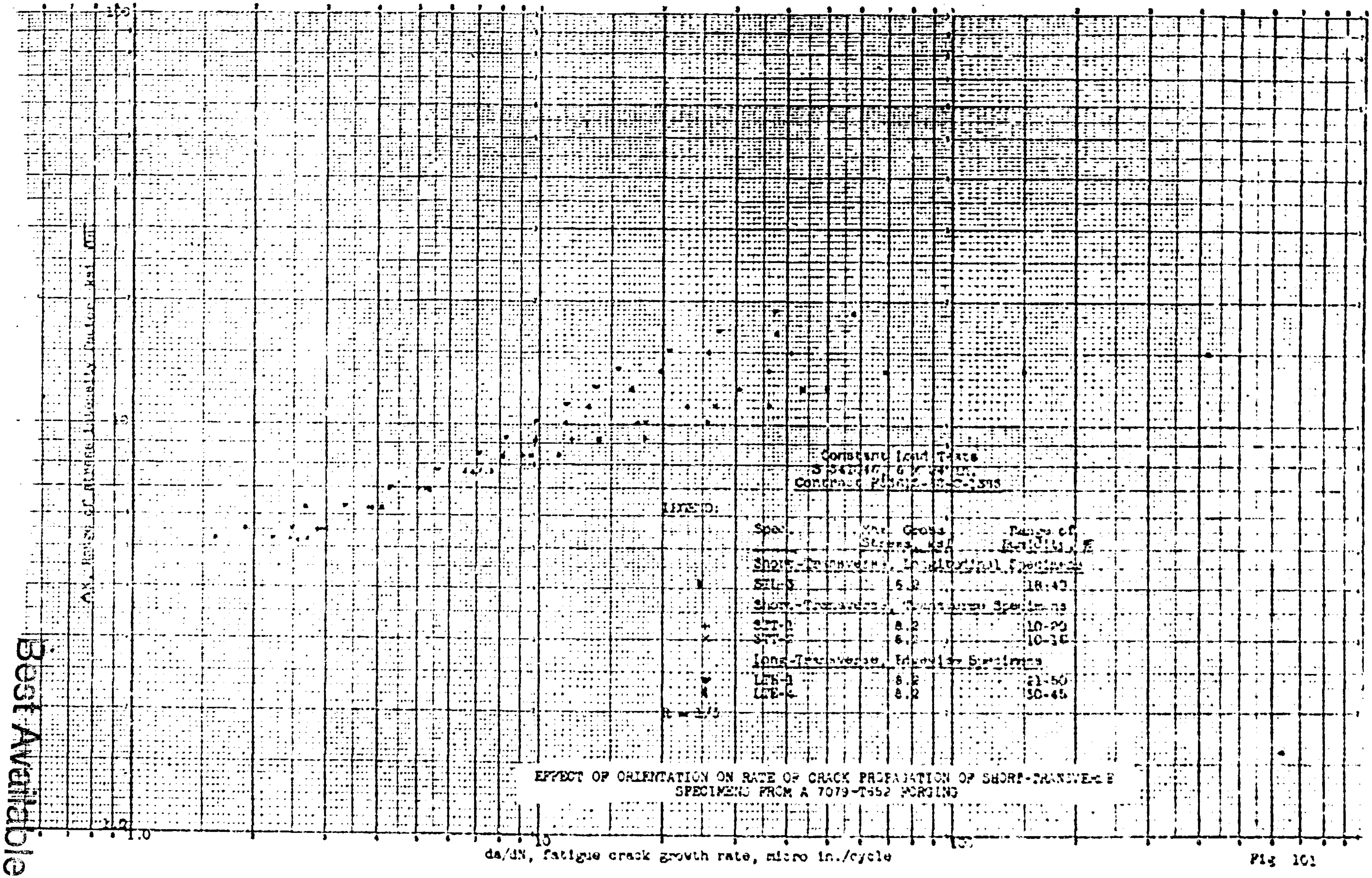

EFFECT OF ORIENTATION ON RATE OF CRACK PROPAGATION OF SHORT-TRANSVERSE SPECIMENS FROM A 7075-T7352 FORGING




EFFECT OF ORIENTATION ON FATIGUE-CRACK PROPAGATION OF SHORT-TRANSVERSE SPECIMENS FROM A 7079-T652 FORGING

Fig. 100

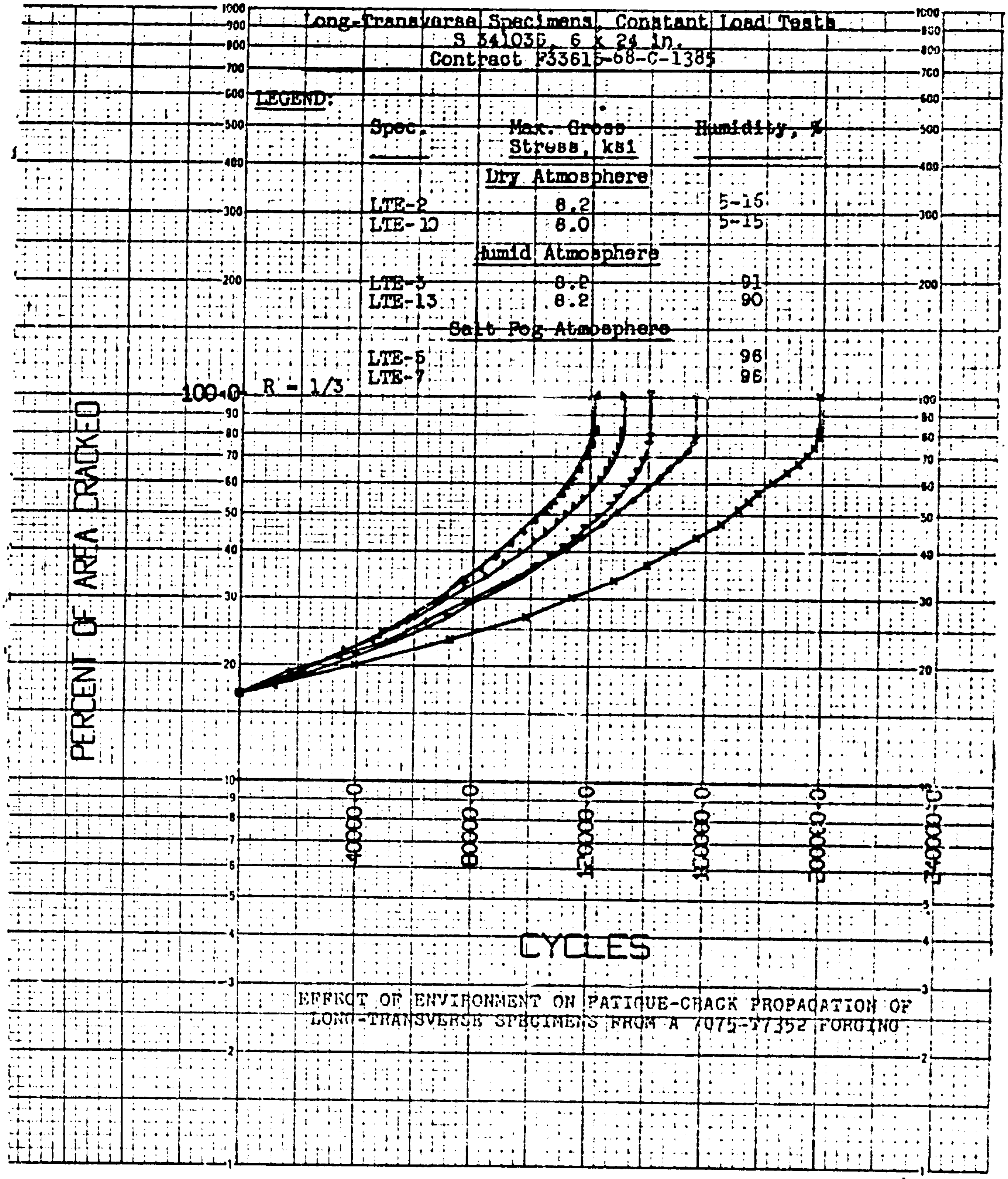
Best Available Copy




EFFECT OF ORIENTATION ON RATE OF CRACK PROPAGATION OF SHORT-TRANSVERSE SPECIMENS FROM A 7079-T652 FORGING

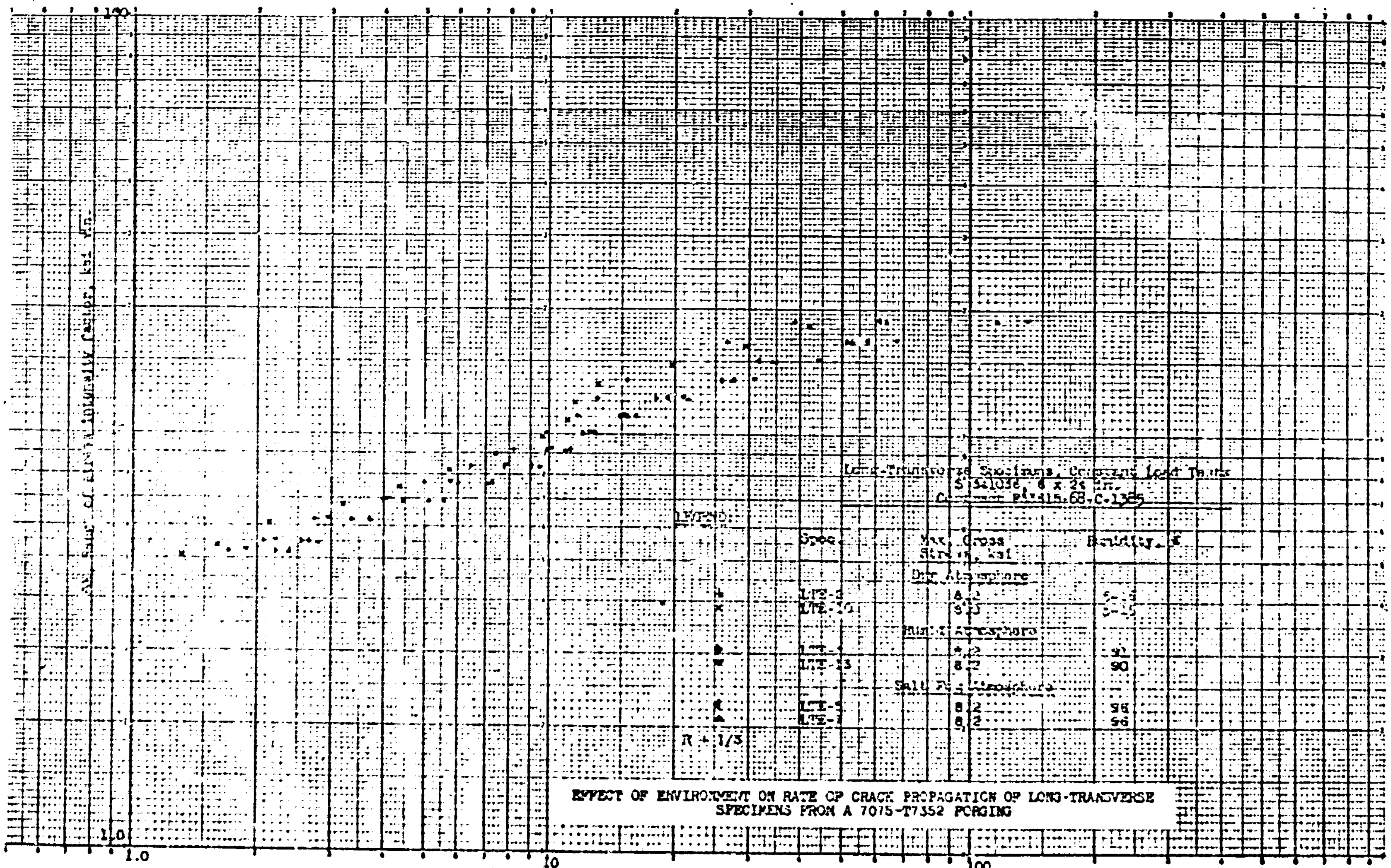
Fig 101

Best Available Copy



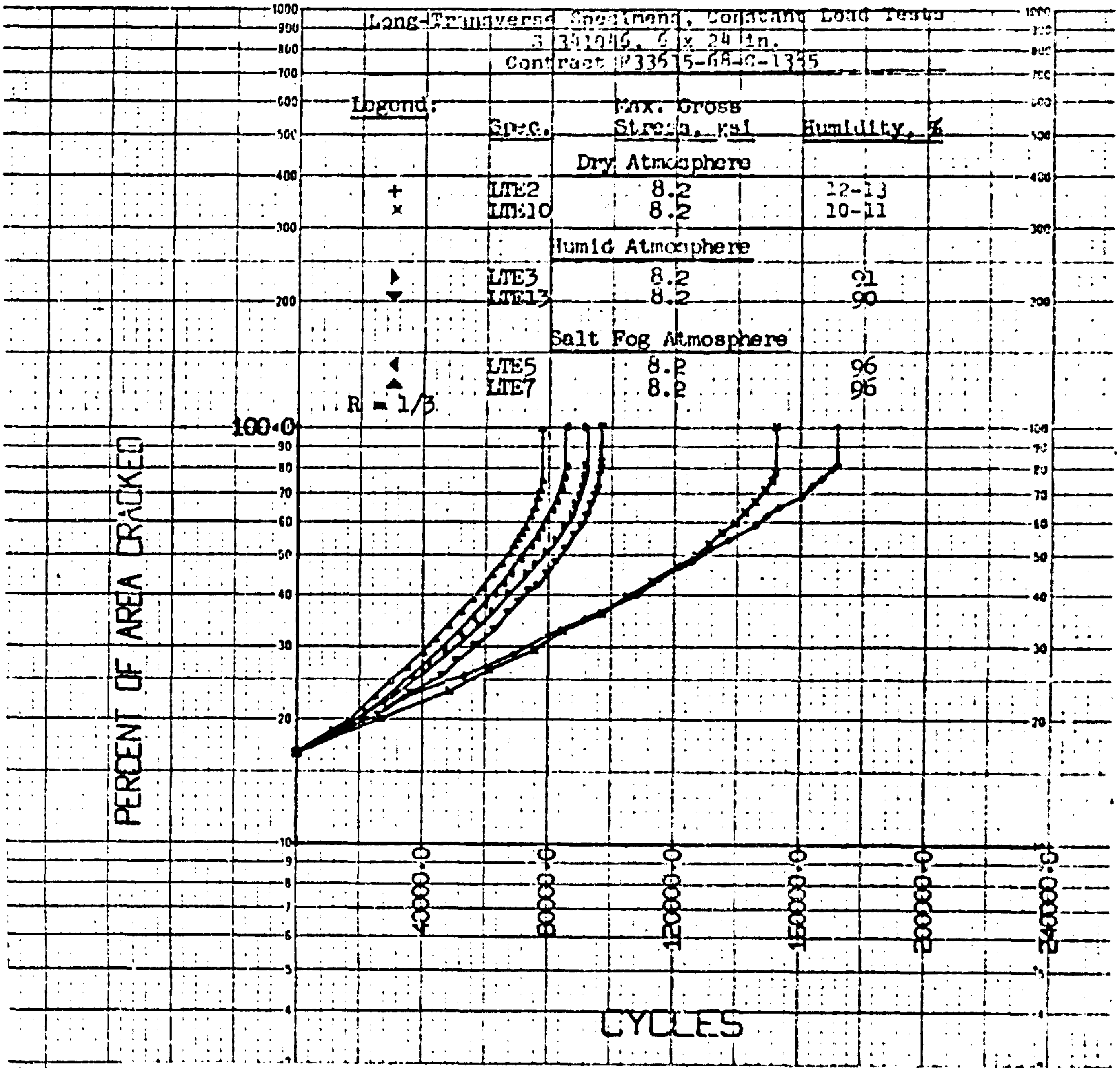

EFFECT OF ENVIRONMENT ON FATIGUE-CRACK PROPAGATION OF LONG-TRANSVERSE SPECIMENS FROM A 7075-T7352 FORGING

Fig. 102



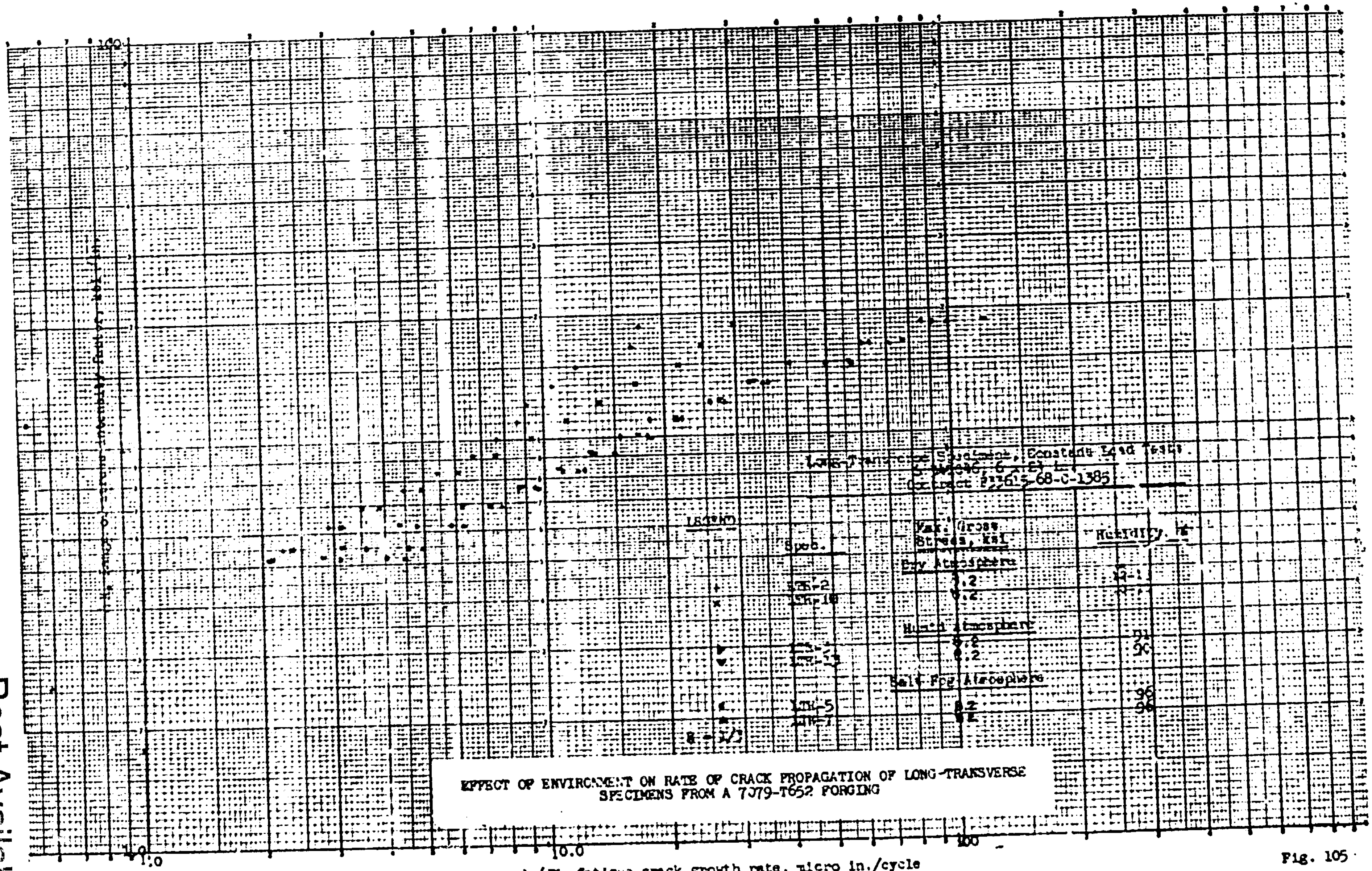

EFFECT OF ENVIRONMENT ON RATE OF CRACK PROPAGATION OF LONG-TRANSVERSE SPECIMENS FROM A 7075-T7352 FORGING

Fig. 103




EFFECT OF ENVIRONMENT ON FATIGUE-CRACK PROPAGATION OF LONG-TRANSVERSE SPECIMENS FROM A 7079-T652 FORGING

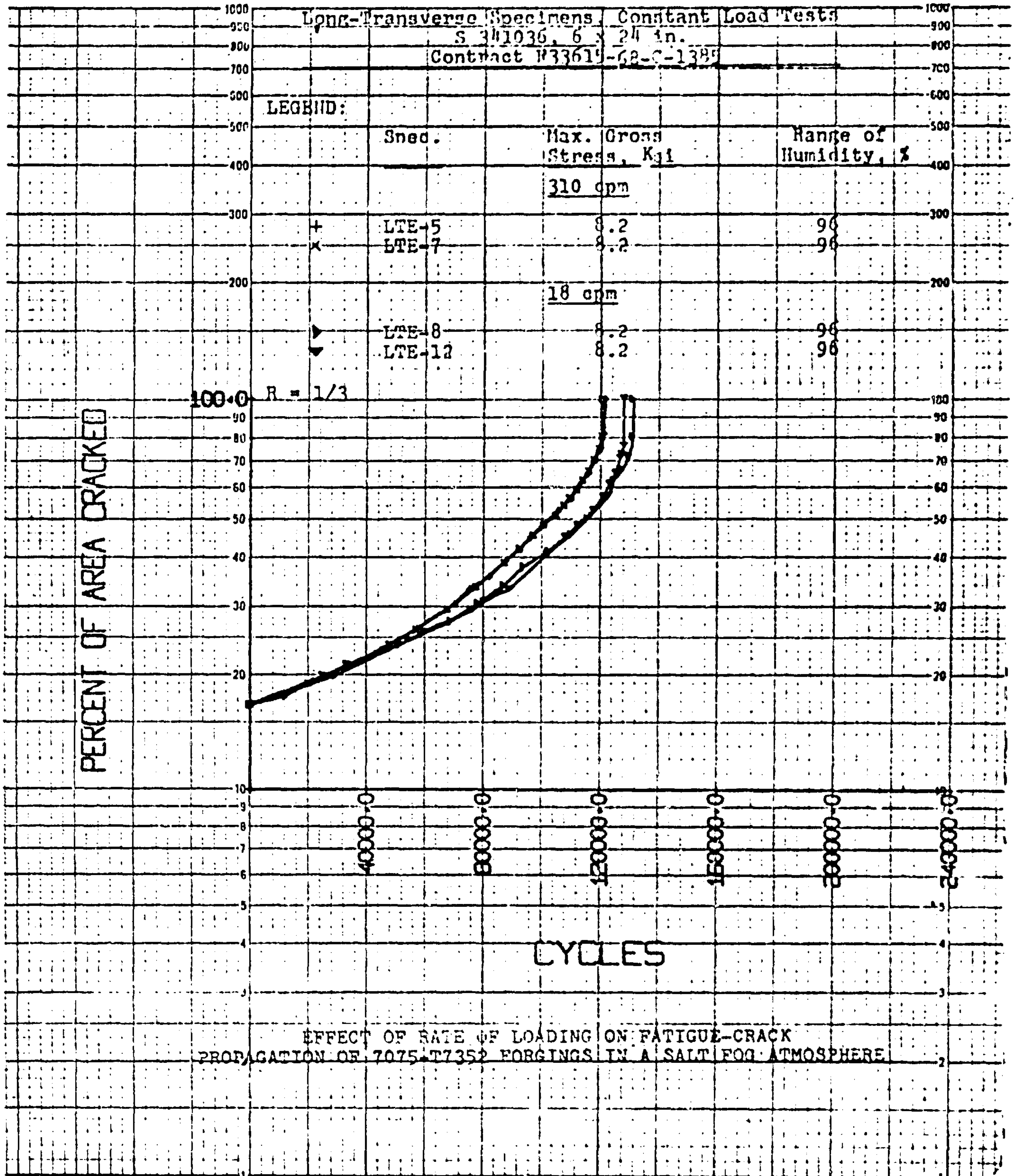
Fig. 104



EFFECT OF ENVIRONMENT ON RATE OF CRACK PROPAGATION OF LONG-TRANSVERSE SPECIMENS FROM A 7079-T652 FORGING

da/dN, fatigue crack growth rate, micro in./cycle

Fig. 105




EFFECT OF RATE OF LOADING ON FATIGUE-CRACK PROPAGATION OF 7075-T7352 FORGINGS IN A SALT FOG ATMOSPHERE

Fig. 106

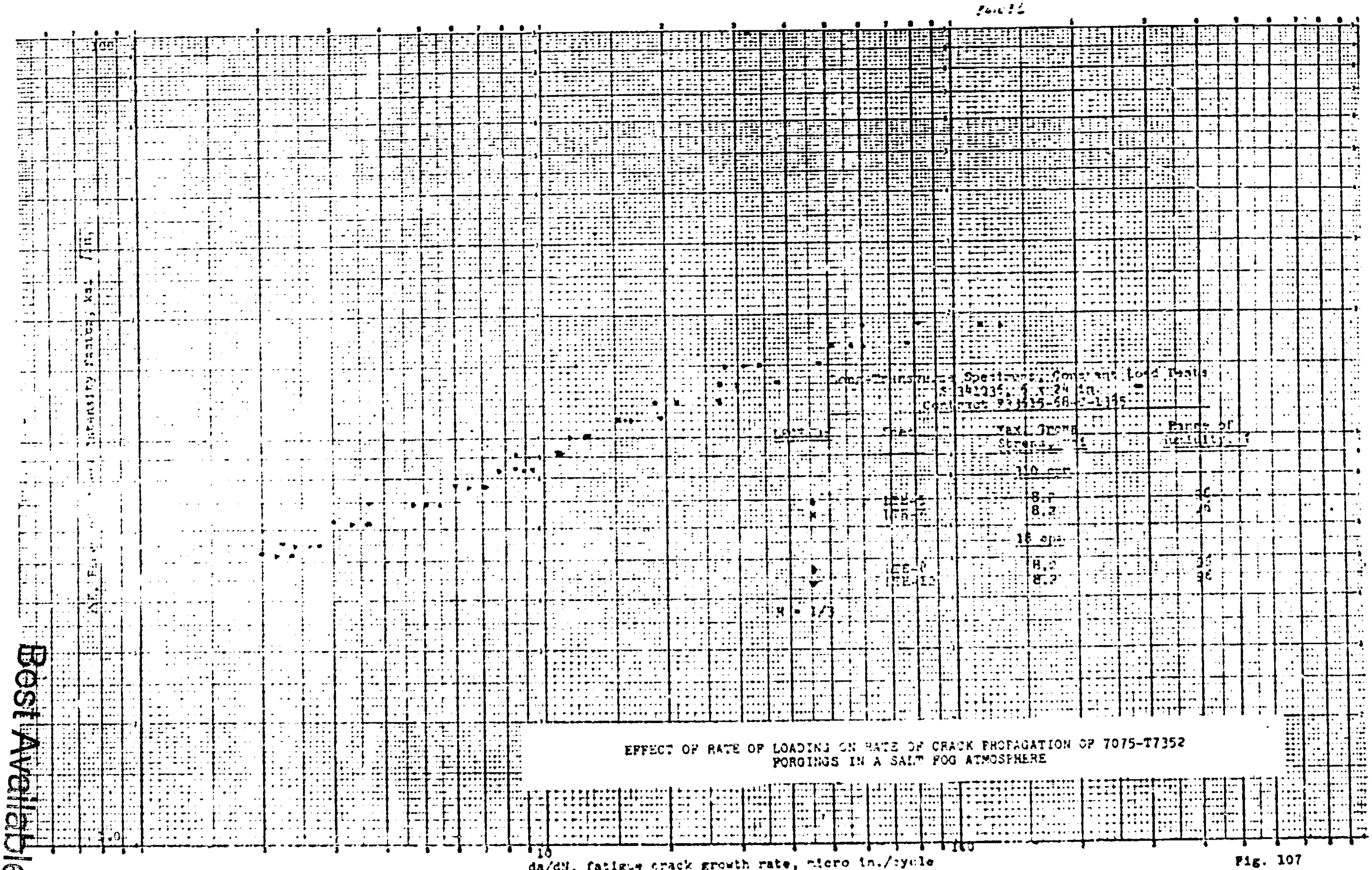
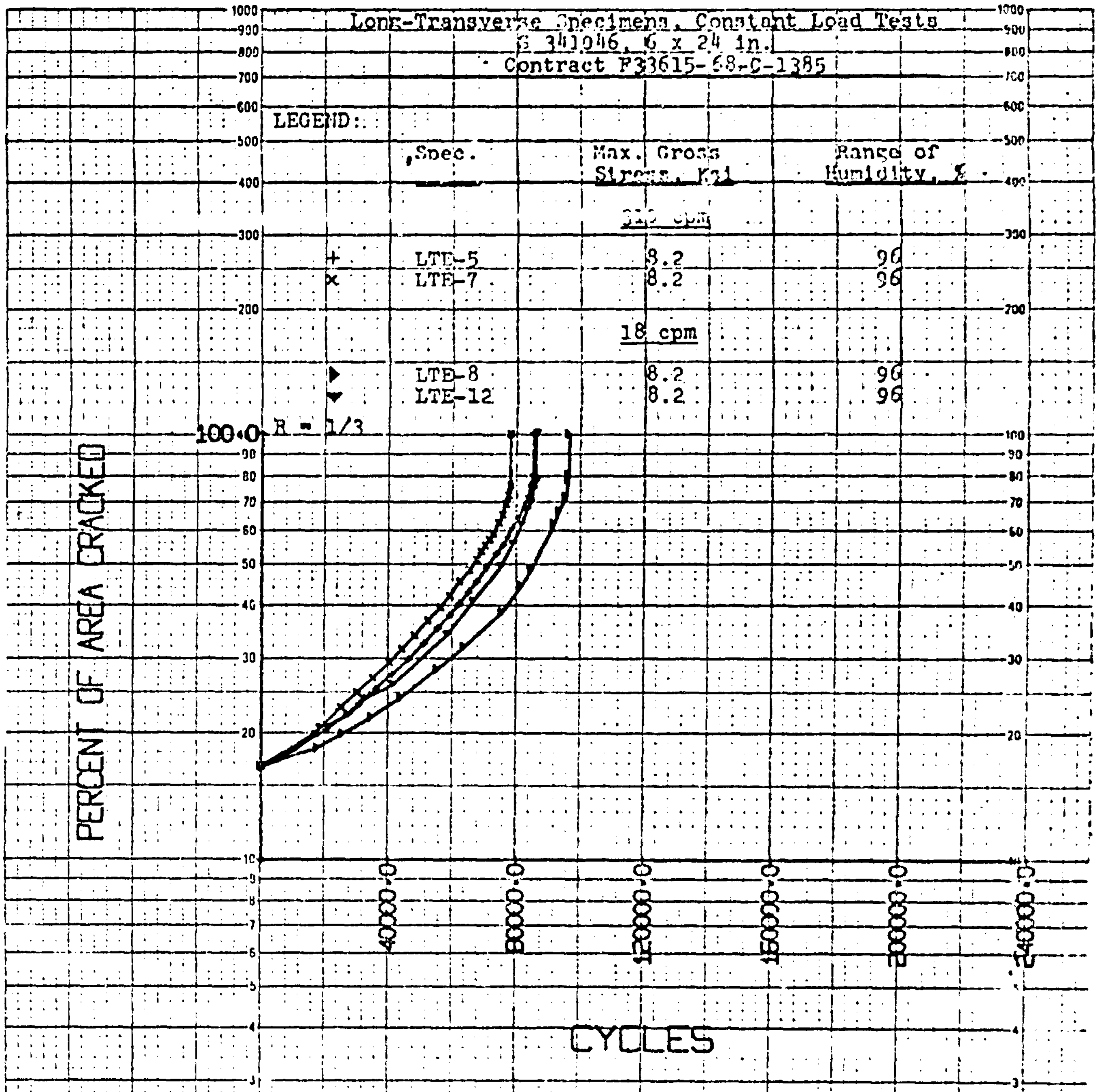

EFFECT OF RATE OF LOADING ON RATE OF CRACK PROPAGATION OF 7075-T7352
FORGINGS IN A SALT FOG ATMOSPHERE
da/dN, fatigue crack growth rate, micro in./cycle
10
100
110 cpm
18 cpm
8.2
M = 1/3

Fig. 107




EFFECT OF RATE OF LOADING ON FATIGUE-CRACK PROPAGATION OF 7079-T652 FORGINGS IN A SALT FOG ATMOSPHERE

FIG. 108

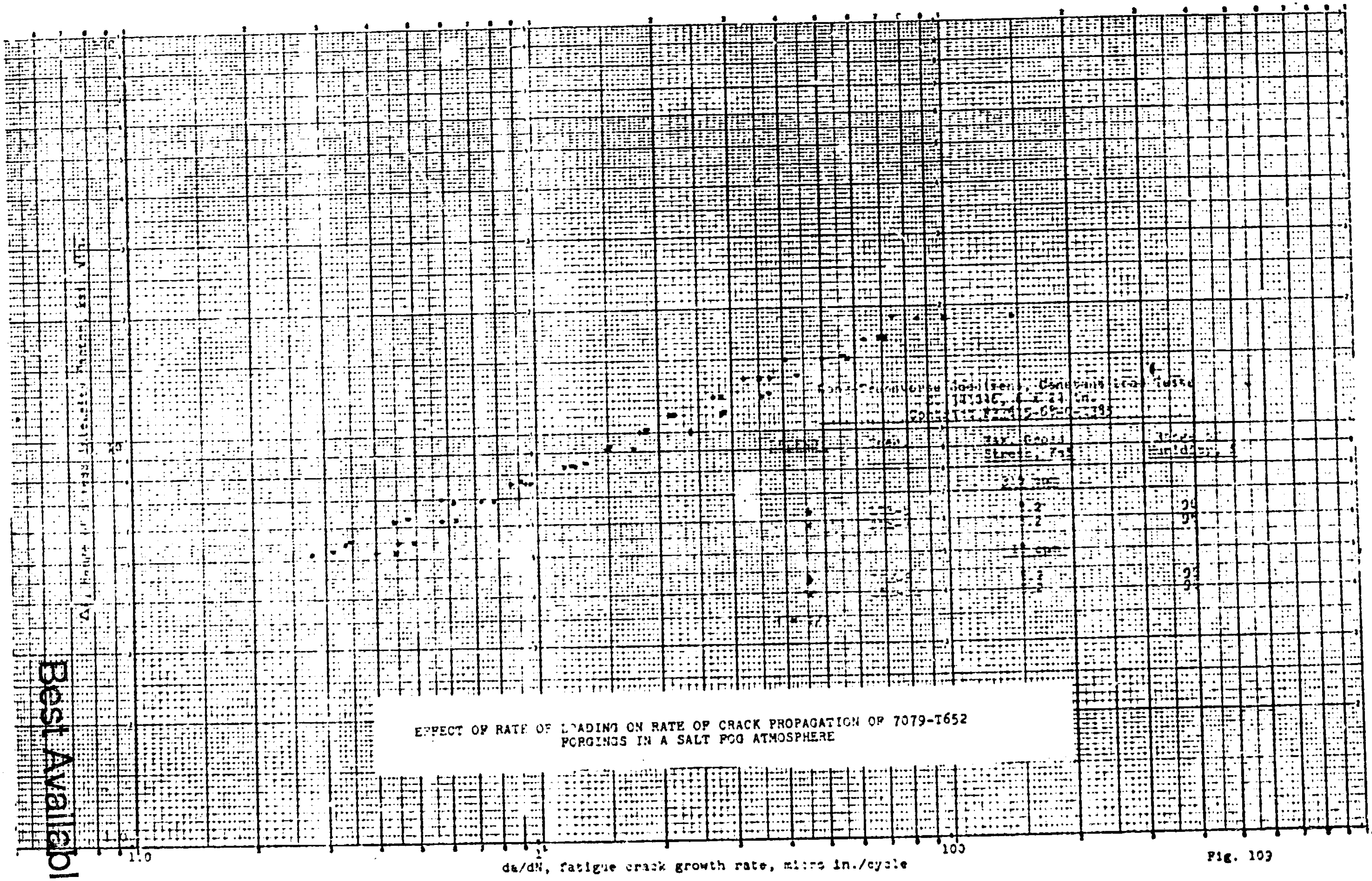
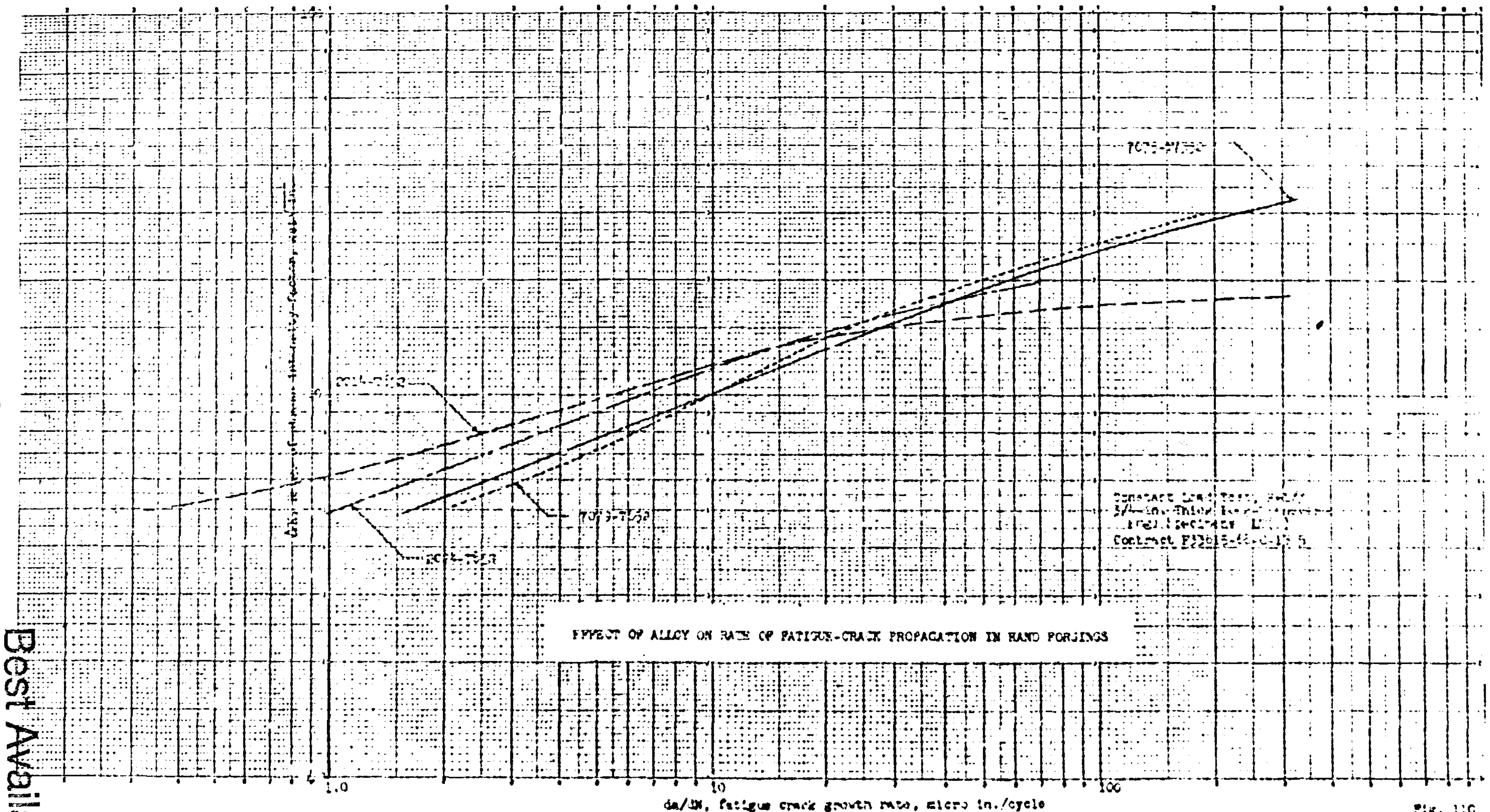


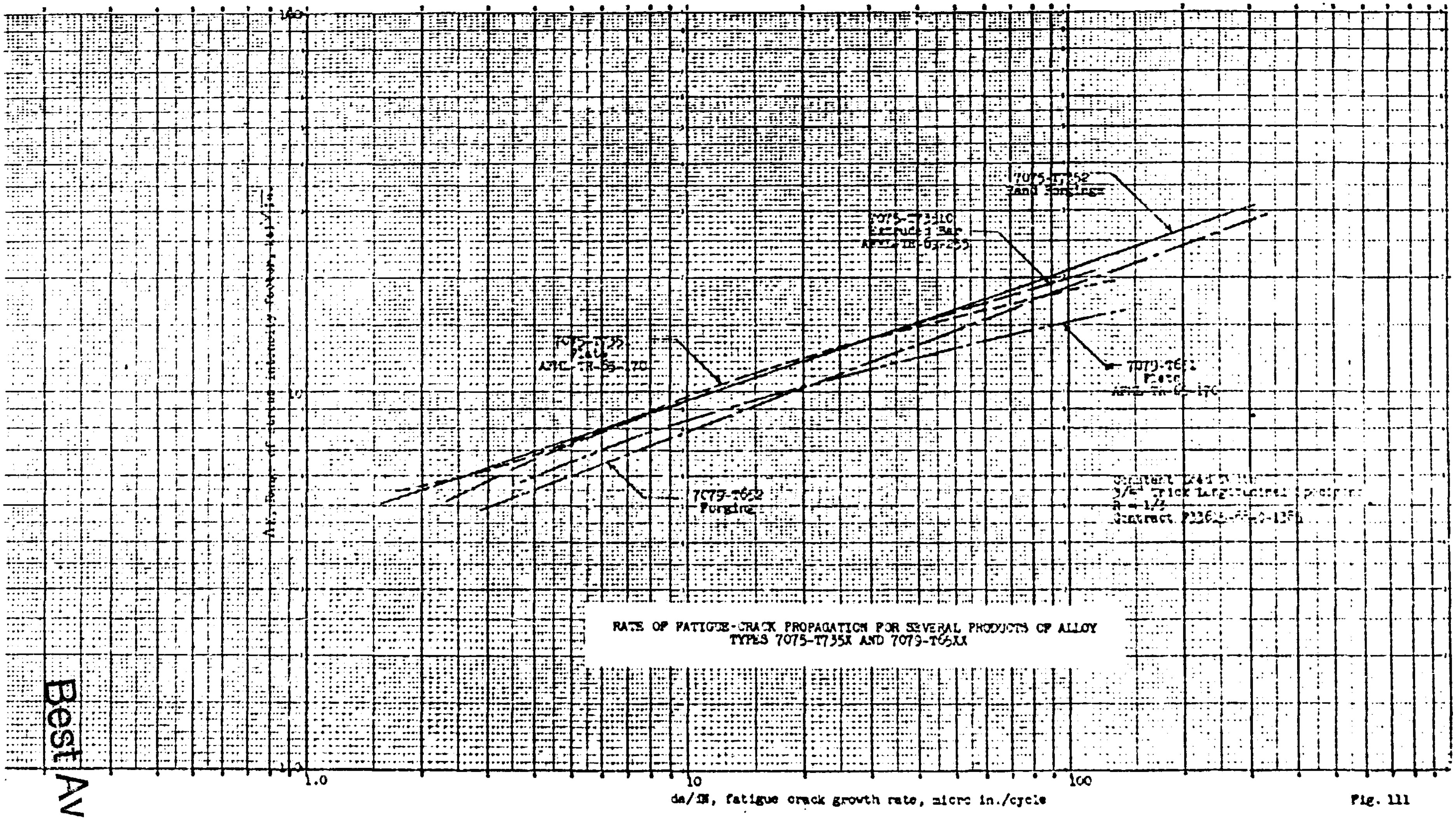

Fig. 103

EFFECT OF RATE OF LOADING ON RATE OF CRACK PROPAGATION OF 7079-T652 FORGINGS IN A SALT FOG ATMOSPHERE



EFFECT OF ALLOY ON RATE OF FATIGUE-CRACK PROPAGATION IN HAND FORGINGS
1.0
10
100
da/dN, fatigue crack growth rate, micro in./cycle


Fig. 110




RATE OF FATIGUE-CRACK PROPAGATION FOR SEVERAL PRODUCTS OF ALLOY TYPES 7075-T735X AND 7079-T65XX

Fig. 111

TABLE I

DESCRIPTION AND CHEMICAL COMPOSITIONS OF STRESS-RELIEVED ALUMINUM ALLOY HAND FORGINGS

(F33615-68-C-1385)

| Alloy and Temper | Sample Cross-Section Size, in. | Sample Number | Cu | Si | Fe | Mn | Mg | Zn | Cr | Ti |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Element, Percent | | | | | | | |
| 2014-T652 | 2x8 | 341007 | 4.41 | 0.97 | 0.24 | 0.73 | 0.50 | 0.14 | 0.01 | 0.04 |
| | 3x12 | 341008 | 4.47 | 0.78 | 0.22 | 0.70 | 0.60 | 0.11 | 0.01 | 0.04 |
| | 4x8 | 341009 | 4.27 | 0.89 | 0.20 | 0.69 | 0.57 | 0.10 | <0.01 | 0.04 |
| | 4x16 | 341010 | 4.58 | 0.94 | 0.22 | 0.72 | 0.69 | 0.08 | 0.01 | 0.04 |
| | 5x5 | 341011 | 4.27 | 0.89 | 0.20 | 0.69 | 0.57 | 0.10 | <0.01 | 0.04 |
| | 5x10 | 341012 | [illegible] | 0.91 | 0.22 | 0.68 | 0.56 | 0.05 | <0.01 | 0.04 |
| | 5x20 | 341013 | 4.36 | 0.93 | 0.24 | 0.70 | 0.40 | 0.08 | 0.01 | 0.05 |
| | 6x6 | 341014 | 4.27 | 0.89 | 0.20 | 0.69 | 0.57 | 0.10 | <0.01 | 0.04 |
| | 6x12 | 341015 | 4.53 | 0.94 | 0.25 | 0.74 | 0.53 | 0.12 | 0.02 | 0.05 |
| | 6x24 | 341016 | 4.41 | 1.00 | 0.22 | 0.69 | 0.37 | 0.03 | 0.01 | 0.04 |
| | Limits* | | 3.9-5.0 | 0.50-1.2 | 1.0 | 0.40-1.2 | 0.20-0.8 | 0.25 | 0.10 | 0.15 |
| 2024-T852 | 2x8 | 341017 | 4.63 | 0.11 | 0.15 | 0.53 | 1.54 | 0.07 | 0.00 | 0.02 |
| | 3x12 | 341018 | 4.63 | 0.11 | 0.15 | 0.53 | 1.54 | 0.07 | 0.00 | 0.02 |
| | 4x8 | 341019 | 4.51 | 0.13 | 0.19 | 0.57 | 1.72 | 0.24 | 0.02 | 0.03 |
| | 4x16 | 341020 | 4.51 | 0.11 | 0.17 | 0.57 | [illegible] | 0.07 | 0.01 | 0.03 |
| | 5x5 | 341021 | 4.51 | 0.13 | 0.19 | 0.57 | 1.72 | 0.24 | 0.02 | 0.03 |
| | 5x10 | 341022 | 4.48 | 0.10 | 0.12 | 0.52 | 1.52 | 0.05 | 0.01 | 0.03 |
| | 5x20 | 341023 | 4.51 | 0.13 | 0.19 | 0.57 | 1.72 | 0.24 | 0.02 | 0.03 |
| | 6x6 | 341024 | 4.35 | 0.12 | 0.16 | 0.57 | 1.54 | 0.07 | 0.00 | 0.02 |
| | 6x12 | 341025 | 4.48 | 0.10 | 0.12 | 0.52 | 1.52 | 0.05 | 0.01 | 0.03 |
| | 6x24 | 341026 | 4.56 | 0.12 | 0.14 | 0.65 | 1.69 | 0.08 | 0.00 | 0.03 |
| | Limits† | | 3.8-4.9 | 0.50 | 0.50 | 0.30-0.9 | 1.2-1.8 | 0.25 | 0.10 | -- |
| 7075-T7352 | 2x8 | 341027 | 1.60 | 0.10 | 0.13 | 0.02 | 2.50 | 5.65 | 0.19 | 0.03 |
| | 3x12 | 341028 | 1.52 | 0.11 | 0.14 | 0.02 | 2.29 | 5.45 | 0.20 | 0.03 |
| | 4x8 | 341029 | 1.48 | 0.07 | 0.16 | 0.02 | 2.54 | 5.77 | 0.20 | 0.02 |
| | 4x16 | 341030 | 1.52 | 0.12 | 0.16 | 0.02 | 2.53 | 5.62 | 0.19 | 0.04 |
| | 5x5 | 341031 | 1.50 | 0.07 | 0.13 | 0.02 | 2.50 | 5.67 | 0.20 | 0.02 |
| | 5x10 | 341032 | 1.53 | 0.11 | 0.14 | 0.03 | 2.57 | 5.82 | 0.19 | 0.05 |
| | 5x20 | 341033 | 1.48 | 0.12 | 0.15 | 0.02 | 2.60 | 5.72 | 0.20 | 0.04 |
| | 6x6 | 341034 | 1.71 | 0.12 | 0.20 | 0.04 | 2.42 | [illegible] | 0.19 | 0.03 |
| | 6x12 | 341035 | 1.65 | 0.17 | 0.20 | 0.04 | 2.45 | 5.48 | 0.20 | 0.04 |
| | 6x24 | 341036 | 1.40 | 0.10 | 0.14 | 0.02 | 2.60 | 5.68 | 0.19 | 0.03 |
| | Limits* | | 1.2-2.0 | 0.50 | 0.7 | 0.30 | 2.1-2.9 | 5.1-6.1 | 0.18-0.40 | 0.20 |
| 7079-T652 | 2x8 | 341037 | 0.76 | 0.11 | 0.18 | 0.18 | 3.48 | 4.57 | 0.14 | 0.03 |
| | 3x12 | 341038 | 0.76 | 0.11 | 0.18 | 0.15 | 3.48 | 4.57 | 0.14 | 0.03 |
| | 4x8 | 341039 | 0.70 | 0.10 | 0.16 | 0.19 | 3.66 | 4.74 | 0.14 | 0.04 |
| | 4x16 | 341040 | 0.65 | 0.08 | 0.14 | 0.18 | 3.51 | 4.40 | 0.15 | 0.03 |
| | 5x5 | 341041 | 0.70 | 0.08 | 0.15 | 0.17 | 3.38 | 4.42 | 0.14 | 0.03 |
| | 5x10 | 341042 | 0.72 | 0.10 | 0.15 | 0.19 | [illegible] | 4.54 | 0.15 | 0.03 |
| | 5x20 | 341043 | 0.80 | 0.11 | 0.18 | 0.18 | 3.45 | [illegible] | 0.15 | 0.02 |
| | 6x6 | 341044 | 0.65 | 0.09 | 0.17 | 0.17 | 3.30 | 4.46 | 0.14 | 0.04 |
| | 6x12 | 341045 | 0.70 | 0.10 | 0.16 | 0.19 | 3.66 | 4.74 | 0.14 | 0.04 |
| | 6x24 | 341046 | 0.72 | 0.10 | 0.16 | 0.17 | 3.55 | 4.60 | 0.15 | 0.02 |
| | Limits* | | 0.40-0.8 | 0.30 | 0.40 | 0.10-0.30 | 2.9-3.7 | 3.8-4.8 | 0.10-0.25 | 0.10 |

* Federal Specification QQ-A-367g and Mil. Spec. MIL-A-22771C

† The Aluminum Association, "Aluminum Standards and Data", April 1968

Maximum unless a range is shown.

TABLE II

MECHANICAL PROPERTIES OF STRESS-RELIEVED 2014-T652 ALUMINUM ALLOY HAND FORGINGS
(F33615-68-C-1385)

| SAMPLE: CROSS-SECTIONAL SIZE, IN. | SAMPLE: NUMBER | SAMPLE: DIREC-TIONS§ | TENSILE: ULT. STRESS, PSI | TENSILE: YIELD STRESS,* PSI | TENSILE: ELONG. IN 2 IN. OR 4D, % | TENSILE: RED. OF AREA, % | COMP. YIELD STRESS,* PSI | SHEAR ULT. STRESS, PSI | BEARING‡ EDGEWISE: ULT. STRESS, PSI e/D=1.5 | BEARING‡ EDGEWISE: ULT. STRESS, PSI e/D=2.0 | BEARING‡ EDGEWISE: YIELD STRESS,† PSI e/D=1.5 | BEARING‡ EDGEWISE: YIELD STRESS,† PSI e/D=2.0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2X 8 | 341007 | L | 71 600 | 66 500 | 11.5 | 30 | 69 200 | 44 200 | 101 000 | 122 500 | 87 800 | 101 600 |
| | | LT | 71 700 | 64 900 | 6.0 | 9 | 70 300 | 43 600 | 101 000 | 130 100 | 89 300 | 100 200 |
| | | ST | 65 400 | 61 400 | 9.4 | 34 | 68 700 | --- | --- | --- | --- | --- |
| 3X12 | 341008 | L | 71 800 | 66 200 | 10.5 | 28 | 66 400 | 42 200 | 102 300 | 132 500 | 89 800 | 107 300 |
| | | LT | 71 000 | 65 100 | 7.5 | 12 | 69 800 | 41 600 | 97 100 | 126 800 | 88 600 | 108 200 |
| | | ST | 69 700 | 62 200 | 5.0 | 7 | 69 700 | 41 300 | --- | --- | --- | --- |
| 4X 6 | 341009 | L | 70 300 | 64 200 | 12.5 | 29 | 66 400 | 40 400 | 89 300 | 123 700 | 85 500 | 103 000 |
| | | LT | 69 900 | 63 000 | 7.5 | 12 | 65 100 | 40 600 | 90 700 | 121 700 | 87 200 | 102 100 |
| | | ST | 66 900 | 59 500 | 2.5 | 4 | 69 300 | 39 900 | --- | --- | --- | --- |
| 4X16 | 341010 | L | 69 100 | 62 500 | 11.5 | 26 | 61 400 | 38 700 | 106 800 | 123 900 | 86 200 | 97 400 |
| | | LT | 66 600 | 59 200 | 6.0 | 8 | 61 500 | 38 600 | 101 900 | 114 900 | 86 500 | 93 900 |
| | | ST | 65 800 | 57 000 | 6.0 | 6 | 61 900 | 38 900 | --- | --- | --- | --- |
| 5X 5 | 341011 | L | 68 600 | 63 200 | 12.0 | 28 | 65 300 | 41 800 | 80 200 | 117 300 | 85 900 | 108 300 |
| | | LT | 67 500 | 61 200 | 4.0 | 5 | 62 500 | 40 700 | 87 200 | 118 400 | 85 900 | 100 400 |
| | | ST | 65 200 | 58 800 | 2.0 | 4 | 66 500 | 41 200 | --- | --- | --- | --- |
| 5X10 | 341012 | L | 66 800 | 61 600 | 11.5 | 27 | 63 000 | 40 600 | 93 400 | 117 400 | 32 700 | 94 800 |
| | | LT | 67 300 | 60 200 | 5.5 | 9 | 61 700 | 40 300 | 88 700 | 123 400 | 83 600 | 99 000 |
| | | ST | 64 600 | 57 400 | 3.0 | 6 | 65 300 | 38 700 | --- | --- | --- | --- |
| 5X20 | 341013 | L | 68 500 | 60 700 | 11.5 | 24 | 61 200 | 38 800 | 90 100 | 113 500 | 79 000 | 94 300 |
| | | LT | 64 700 | 57 300 | 5.0 | 7 | 63 500 | 38 400 | 86 600 | 117 500 | 79 000 | 94 700 |
| | | ST | 63 900 | 56 100 | 3.7 | 7 | 62 800 | 37 300 | --- | --- | --- | --- |
| 6X 6 | 341014 | L | 67 700 | 62 000 | 12.0 | 31 | 64 000 | 42 400 | 97 400 | 114 200 | 86 700 | 97 500 |
| | | LT | 64 900 | 59 500 | 3.5 | 5 | 60 400 | 40 700 | 89 300 | 121 100 | 83 900 | 101 100 |
| | | ST | 64 200 | 55 900 | 2.8 | 1 | 65 700 | 40 500 | --- | --- | --- | --- |
| 6X12 | 341015 | L | 66 200 | 59 500 | 11.0 | 27 | 60 300 | 40 200 | 91 100 | 120 100 | 81 600 | 96 100 |
| | | LT | 64 200 | 58 400 | 3.5 | 6 | 61 900 | 38 600 | 87 700 | 119 000 | 80 600 | 98 800 |
| | | ST | 63 900 | 55 000 | 3.5 | 2 | 61 900 | 38 700 | --- | --- | --- | --- |
| 6X24 | 341016 | L | 63 000 | 55 400 | 9.5 | 19 | 57 900 | 42 500 | 89 500 | 118 100 | 81 200 | 99 700 |
| | | LT | 66 600 | 57 700 | 6.0 | 6 | 62 400 | 38 800 | 86 300 | 117 900 | 80 000 | 98 900 |
| | | ST | 62 600 | 54 000 | 6.0 | 14 | 59 300 | 39 000 | --- | --- | --- | --- |

* OFFSET EQUALS 0.2 PER CENT
† OFFSET EQUALS 2 PER CENT OF PIN DIAMETER
‡ SPECIMENS AND FIXTURES CLEANED ULTRASONICALLY
§ L, LONGITUDINAL; LT, LONG TRANSVERSE; ST, SHORT TRANSVERSE

TABLE III

MECHANICAL PROPERTIES OF STRESS-RELIEVED 2024-T852 ALUMINUM ALLOY HAND FORGINGS
(F33615-68-C-1385)

| SAMPLE | | | TENSILE | | | | COMP. | SHEAR | BEARING‡ EDGEWISE | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | ULT. STRESS, PSI | | YIELD STRESS,* PSI | |
| CROSS-SECTIONAL SIZE, IN. | NUMBER | DIRECTION§ | ULT. STRESS, PSI | YIELD STRESS,* PSI | ELONG. IN 2 IN. OR 4D, % | RED. OF AREA, % | YIELD STRESS,* PSI | ULT. STRESS, PSI | e/D=1.5 | e/D=2.0 | e/D=1.5 | e/D=2.0 |
| 2X 8 | 341017 | L | 70 800 | 64 600 | 7.0 | 28 | 70 200 | 42 700 | 97 700 | 133 100 | 95 500 | 116 300 |
| | | LT | 72 300 | 63 800 | 9.0 | 17 | 72 700 | 41 800 | 94 500 | 125 900 | 89 500 | 114 200 |
| | | ST | 67 400 | 64 000 | 1.6 | 3 | 74 600 | --- | --- | --- | --- | --- |
| 3X12 | 341018 | L | 72 200 | 66 700 | 5.5 | 18 | 70 000 | 42 400 | 94 900 | 123 400 | 93 700 | 109 300 |
| | | LT | 73 700 | 69 000 | 3.0 | [illegible] | 75 800 | 42 000 | 94 500 | 126 100 | 93 500 | 113 300 |
| | | ST | 68 100 | 64 400 | 1.0 | 2 | 72 200 | 40 200 | --- | --- | --- | --- |
| 4X 8 | 341019 | L | 68 900 | 61 100 | 9.0 | 26 | 62 200 | 40 500 | 91 900 | 117 900 | 82 500 | 100 500 |
| | | LT | 70 400 | 63 200 | 5.0 | 8 | 63 500 | 39 500 | 88 800 | 119 400 | 82 800 | 101 000 |
| | | ST | 65 700 | 57 200 | 3.2 | 4 | 65 500 | 38 600 | --- | --- | --- | --- |
| 4X16 | 341020 | L | 71 400 | 65 400 | 6.5 | 23 | 66 600 | 41 100 | 92 100 | 124 000 | 87 400 | 104 800 |
| | | LT | 71 000 | 65 200 | 5.0 | 8 | 71 500 | 40 200 | 91 500 | 127 100 | 90 500 | 108 200 |
| | | ST | 70 100 | 60 600 | 2.4 | 6 | 70 200 | 39 900 | --- | --- | --- | --- |
| 5X 5 | 341021 | L | 69 000 | 62 000 | 8.5 | 29 | 63 400 | 40 800 | 93 500 | 125 200 | 89 900 | 105 100 |
| | | LT | 68 400 | 62 100 | 3.0 | 1 | 63 100 | 40 700 | 89 100 | 121 600 | 84 400 | 101 100 |
| | | ST | 66 500 | 56 000 | 2.8 | 4 | 64 700 | 39 600 | --- | --- | --- | --- |
| 5X10 | 341022 | L | 68 400 | 61 000 | 8.5 | 25 | 63 000 | 40 300 | 89 100 | 114 300 | 87 700 | 96 800 |
| | | LT | 69 100 | 61 500 | 6.0 | 8 | 64 800 | 39 700 | 89 500 | 120 200 | 85 100 | 99 600 |
| | | ST | 66 100 | 59 800 | 1.5 | 4 | 68 400 | 38 800 | --- | --- | --- | --- |
| 5X20 | 341023 | L | 65 200 | 55 100 | 9.0 | 16 | 57 800 | 38 800 | 83 600 | 112 600 | 79 300 | 94 400 |
| | | LT | 62 800 | 56 700 | 3.0 | 4 | 60 700 | 38 000 | 84 900 | 114 600 | 82 500 | 98 000 |
| | | ST | 63 200 | 54 500 | 3.0 | 3 | 59 400 | 37 000 | --- | --- | --- | --- |
| 6X 6 | 341024 | L | 69 100 | 61 600 | 9.0 | 28 | 63 700 | 41 500 | 95 300 | 123 900 | 89 800 | 102 200 |
| | | LT | 68 800 | 60 600 | 6.5 | 10 | 61 500 | 40 600 | 92 000 | 123 200 | 86 900 | 102 700 |
| | | ST | 69 400 | 58 500 | 2.3 | 3 | 67 600 | 39 800 | --- | --- | --- | --- |
| 6X12 | 341025 | L | 67 000 | 58 700 | 8.0 | 22 | 59 700 | 39 600 | 84 700 | 117 100 | 82 400 | 100 500 |
| | | LT | 67 400 | 60 200 | 3.2 | 4 | 63 500 | 38 400 | 85 700 | 113 400 | 81 400 | 95 700 |
| | | ST | 65 300 | 55 100 | 2.9 | 3 | 63 000 | 37 400 | --- | --- | --- | --- |
| 6X24 | 341026 | L | 64 300 | 56 100 | 7.5 | 20 | 56 000 | 37 100 | 80 900 | 111 700 | 80 500 | 95 000 |
| | | LT | 65 400 | 57 800 | 5.0 | 8 | 57 500 | 36 100 | 84 300 | 98 600 | 79 900 | 90 600 |
| | | ST | 58 000 | 53 900 | 1.0 | 1 | 58 000 | 34 900 | --- | --- | --- | --- |

* OFFSET EQUALS 0.2 PER CENT
† OFFSET EQUALS 2 PER CENT OF PIN DIAMETER
‡ SPECIMENS AND FIXTURES CLEANED ULTRASONICALLY
§ L, LONGITUDINAL; LT, LONG TRANSVERSE; ST, SHORT TRANSVERSE

# TABLE IV

## MECHANICAL PROPERTIES OF STRESS-RELIEVED 7075-T7352 ALUMINUM ALLOY HAND FORGINGS (F33615-68-C-1385)

| SAMPLE | | | TENSILE | | | | COMP. | SHEAR | BEARING ‡ EDGEWISE | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | ULT. STRESS, PSI | | YIELD STRESS, † PSI | |
| CROSS-SECTIONAL SIZE, IN. | NUMBER | DIRECTION § | ULT. STRESS, PSI | YIELD STRESS, * PSI | ELONG. IN 2 IN. OR 4D, % | RED. OF AREA, % | YIELD STRESS, * PSI | ULT. STRESS, PSI | e/D=1.5 | e/D=2.0 | e/D=1.5 | e/D=2.0 |
| 2X 8 | 341027 | L | 73 700 | 65 300 | 13.5 | 43 | 69 300 | 46 800 | 111 900 | 147 200 | 93 700 | 111 200 |
| | | LT | 74 900 | 65 300 | 13.5 | 29 | 68 800 | 44 500 | 110 600 | 146 300 | 92 700 | 106 500 |
| | | ST | 73 100 | 61 800 | 6.3 | 9 | 69 300 | --- | --- | --- | --- | --- |
| 3X12 | 341028 | L | 76 400 | 66 200 | 11.5 | 27 | 66 900 | 42 400 | 103 100 | 136 100 | 89 000 | 103 800 |
| | | LT | 71 400 | 59 300 | 8.0 | 11 | 65 300 | 42 600 | 98 300 | 135 100 | 89 800 | 110 300 |
| | | ST | 73 000 | 60 800 | 4.2 | 5 | 69 300 | 42 900 | --- | --- | --- | --- |
| 4X 8 | 341029 | L | 68 400 | 57 300 | 15.0 | 42 | 60 200 | 39 800 | 95 100 | 130 000 | 83 500 | 98 600 |
| | | LT | 65 100 | 53 000 | 10.0 | 17 | 57 600 | 38 400 | 98 500 | 127 100 | 81 400 | 99 000 |
| | | ST | 64 500 | 50 600 | 6.4 | 10 | 57 500 | 38 200 | --- | --- | --- | --- |
| 4X16 | 341030 | L | 70 000 | 59 500 | 13.0 | 34 | 59 600 | 40 600 | 95 300 | 126 000 | 82 900 | 95 800 |
| | | LT | 67 600 | 55 200 | 12.0 | 25 | 59 700 | 40 700 | 94 200 | 125 500 | 82 600 | 99 200 |
| | | ST | 64 800 | 52 500 | 6.4 | 7 | 58 600 | 39 100 | --- | --- | --- | --- |
| 5X 5 | 341031 | L | 68 400 | 56 700 | 14.0 | 39 | 59 400 | 41 500 | 104 400 | 131 600 | 84 300 | 99 000 |
| | | LT | 67 200 | 55 100 | 10.5 | 20 | 56 600 | 40 600 | 98 000 | 131 800 | 83 500 | 100 700 |
| | | ST | 63 800 | 51 700 | 4.0 | 6 | 59 500 | 41 500 | --- | --- | --- | --- |
| 5X10 | 341032 | L | 65 200 | 52 700 | 14.0 | 37 | 53 400 | 39 600 | 95 900 | 124 600 | 82 300 | 91 900 |
| | | LT | 64 000 | 51 400 | 9.0 | 17 | 53 800 | 38 500 | 97 700 | 127 100 | 80 100 | 97 000 |
| | | ST | 64 200 | 49 500 | 7.0 | 9 | 58 000 | 39 400 | --- | --- | --- | --- |
| 5X20 | 341033 | L | 64 800 | 52 500 | 14.5 | 35 | 52 200 | 38 900 | 94 100 | 120 300 | 76 800 | 89 100 |
| | | LT | 64 000 | 50 700 | 11.0 | 25 | 54 400 | 38 300 | 91 500 | 119 400 | 77 100 | 92 600 |
| | | ST | 63 700 | 49 300 | 6.5 | 10 | 54 900 | 38 000 | --- | --- | --- | --- |
| 6X 6 | 341034 | L | 62 400 | 51 100 | 15.0 | 44 | 54 000 | 41 300 | 99 300 | 131 200 | 82 100 | 94 400 |
| | | LT | 63 800 | 52 100 | 10.0 | 23 | 53 000 | 40 100 | 97 400 | 128 400 | 81 600 | 96 100 |
| | | ST | 63 400 | 49 700 | 8.0 | 14 | 55 300 | 39 000 | --- | --- | --- | --- |
| 6X12 | 341035 | L | 63 300 | 52 600 | 12.5 | 34 | 50 300 | 39 800 | 98 700 | 123 700 | 80 000 | 94 600 |
| | | LT | 63 400 | 50 900 | 9.0 | 14 | 51 200 | 38 800 | 95 000 | 123 700 | 79 400 | 95 000 |
| | | ST | 60 800 | 49 800 | 6.5 | 9 | 54 400 | 37 400 | --- | --- | --- | --- |
| 6X24 | 341036 | L | 65 800 | 55 400 | 12.5 | 34 | 51 400 | 38 700 | 93 700 | 113 600 | 76 000 | 84 900 |
| | | LT | 62 100 | 50 300 | 9.5 | 16 | 52 300 | 39 000 | 85 600 | 108 700 | 71 600 | 82 700 |
| | | ST | 62 600 | 49 200 | 6.5 | 10 | 53 800 | 37 200 | --- | --- | --- | --- |

* OFFSET EQUALS 0.2 PER CENT
† OFFSET EQUALS 2 PER CENT OF PIN DIAMETER
‡ SPECIMENS AND FIXTURES CLEANED ULTRASONICALLY
§ L, LONGITUDINAL; LT, LONG TRANSVERSE; ST, SHORT TRANSVERSE

TABLE V

MECHANICAL PROPERTIES OF STRESS-RELIEVED 7079-T652 ALUMINUM ALLOY HAND FORGINGS
(F33615-68-C-1385)

| SAMPLE | | | TENSILE | | | | COMP. | SHEAR | BEARING‡ EDGEWISE | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | ULT. STRESS, PSI | | YIELD STRESS,† PSI | |
| CROSS-SECTIONAL SIZE, IN. | NUMBER | DIRECTION§ | ULT. STRESS, PSI | YIELD STRESS,* PSI | ELONG. IN 2 IN. OR 4D, % | RED. OF AREA, % | YIELD STRESS,* PSI | ULT. STRESS, PSI | e/D=1.5 | e/D=2.0 | e/D=1.5 | e/D=2.0 |
| 2X 8 | 341037 | L | 78 600 | 71 000 | 14.0 | 34 | 73 300 | 48 700 | 115 100 | 154 700 | 99 100 | 114 400 |
| | | LT | 76 100 | 64 900 | 12.0 | 20 | 73 200 | 46 500 | 114 500 | 149 100 | 98 000 | 113 400 |
| | | ST | 76 000 | 63 700 | 7.8 | 10 | 74 200 | --- | --- | --- | --- | --- |
| 3X12 | 341038 | L | 77 500 | 68 700 | 13.0 | 26 | 71 300 | 46 400 | 113 200 | 148 800 | 94 800 | 112 900 |
| | | LT | 76 100 | 65 700 | 12.0 | 26 | 70 700 | 46 100 | 116 600 | 149 100 | 97 900 | 114 600 |
| | | ST | 73 700 | 61 400 | 8.0 | 11 | 71 800 | 45 400 | --- | --- | --- | --- |
| 4X 8 | 341039 | L | 78 800 | 69 600 | 11.0 | 21 | 72 800 | 48 900 | 111 600 | 148 300 | 99 400 | 115 200 |
| | | LT | 77 500 | 66 500 | 11.5 | 24 | 72 900 | 48 200 | 117 100 | 148 700 | 102 300 | 117 200 |
| | | ST | 74 300 | 62 800 | 5.0 | 6 | 73 200 | 47 300 | --- | --- | --- | --- |
| 4X16 | 341040 | L | 77 900 | 68 000 | 12.0 | 22 | 70 100 | 46 600 | 113 000 | 145 900 | 95 200 | 110 300 |
| | | LT | 74 600 | 63 000 | 9.5 | 18 | 66 800 | 45 700 | 107 500 | 144 400 | 94 010 | 105 700 |
| | | ST | 74 000 | 62 900 | 7.9 | 17 | 70 600 | 44 900 | --- | --- | --- | --- |
| 5X 5 | 341041 | L | 75 600 | 67 600 | 13.0 | 27 | 69 700 | 47 900 | 112 600 | 149 900 | 94 400 | 108 900 |
| | | LT | 72 900 | 63 000 | 8.5 | 12 | 67 000 | 45 900 | 105 200 | 143 600 | 92 100 | 107 800 |
| | | ST | 71 300 | 59 500 | 7.0 | 10 | 68 400 | 46 300 | --- | --- | --- | --- |
| 5X10 | 341042 | L | 76 100 | 68 000 | 13.0 | 27 | 68 800 | 45 700 | 108 200 | 140 900 | 92 800 | 107 000 |
| | | LT | 74 100 | 62 600 | 10.5 | 19 | 69 300 | 45 900 | 108 300 | 141 300 | 94 300 | 109 100 |
| | | ST | 73 000 | 61 300 | 5.5 | 5 | 72 200 | 44 400 | --- | --- | --- | --- |
| 5X20 | 341043 | L | 76 900 | 65 600 | 13.0 | 24 | 67 000 | 46 200 | 104 600 | 135 900 | 91 800 | 106 400 |
| | | LT | 73 300 | 61 400 | 11.0 | 19 | 65 700 | 46 400 | 103 300 | 136 900 | 89 800 | 105 400 |
| | | ST | 71 300 | 58 300 | 6.0 | 7 | 63 300 | 44 000 | --- | --- | --- | --- |
| 6X 6 | 341044 | L | 73 600 | 63 800 | 15.0 | 37 | 68 900 | 48 400 | 112 200 | 148 100 | 95 600 | 115 400 |
| | | LT | 72 600 | 61 400 | 9.0 | 16 | 69 700 | 47 900 | 111 000 | 146 000 | 96 700 | 109 400 |
| | | ST | 71 700 | 61 800 | 8.5 | 14 | 67 100 | 47 300 | --- | --- | --- | --- |
| 6X12 | 341045 | L | 75 200 | 65 700 | 11.0 | 25 | 67 500 | 46 300 | 109 000 | 139 300 | 93 800 | 107 500 |
| | | LT | 72 800 | 62 100 | 7.5 | 12 | 66 200 | 45 500 | 104 000 | 140 700 | 92 300 | 107 600 |
| | | ST | 72 400 | 58 800 | 6.0 | 7 | 69 300 | 44 700 | --- | --- | --- | --- |
| 6X24 | 341046 | L | 73 900 | 63 900 | 12.0 | 22 | 63 300 | 43 800 | 94 300 | 128 300 | 85 200 | 98 100 |
| | | LT | 69 100 | 57 500 | 10.0 | 22 | 62 900 | 42 000 | 87 700 | 123 300 | 83 300 | 97 200 |
| | | ST | 69 300 | 58 100 | 4.5 | 6 | 67 300 | 42 000 | --- | --- | --- | --- |

* OFFSET EQUALS 0.2 PER CENT
† OFFSET EQUALS 2 PER CENT OF PIN DIAMETER
‡ SPECIMENS AND FIXTURES CLEANED ULTRASONICALLY
§ L, LONGITUDINAL; LT, LONG TRANSVERSE; ST, SHORT TRANSVERSE

TABLE VI

SPECIFIED MINIMUM VALUES FOR STRESS-RELIEVED ALUMINUM ALLOY HAND FORGINGS†
(F33615-68-C-1385)

| Alloy and Temper | Thickness, in. | Longitudinal: Ultimate Tensile Stress, psi | Longitudinal: Tensile Yield Stress,* psi | Longitudinal: Elong. in 4D, % | Long-Transverse: Ultimate Tensile Stress, psi | Long-Transverse: Tensile Yield Stress,* psi | Long-Transverse: Elong. in 4D, % | Short-Transverse: Ultimate Tensile Stress, psi | Short-Transverse: Tensile Yield Stress,* psi | Short-Transverse: Elong. in 4D, % | Specification |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 2014-T652 | Up thru 2.000 | 65 000 | 56 000 | 8 | 65 000 | 56 000 | 3 | --- | --- | -- | MIL-A-22771C QQ-A-367g |
| | 2.001-3.000 | 64 000 | 56 000 | 8 | 64 000 | 55 000 | 3 | 62 000 | 52 000 | 2 | |
| | 3.001-4.000 | 63 000 | 55 000 | 8 | 63 000 | 55 000 | 3 | 61 000 | 51 000 | 2 | |
| | 4.001-5.000 | 62 000 | 54 000 | 7 | 62 000 | 54 000 | 2 | 60 000 | 50 000 | 1 | |
| | 5.001-6.000 | 61 000 | 53 000 | 7 | 61 000 | 53 000 | 2 | 59 000 | 50 000 | 1 | |
| 2024-T852 | All | --- | --- | - | --- | --- | - | --- | --- | - | None |
| 7075-T7352 | Up thru 3.000 | 66 000 | 54 000 | 7 | 64 000 | 52 000 | 4 | 61 000 | 50 000 | 3 | MIL-A-22771C |
| | 3.001-4.000 | 64 000 | 53 000 | 7 | 63 000 | 50 000 | 3 | 60 000 | 48 000 | 2 | |
| | 4.001-5.000 | 62 000 | 51 000 | 7 | 61 000 | 48 000 | 3 | 58 000 | 46 000 | 2 | |
| | 5.001-6.000 | 61 000 | 49 000 | 6 | 59 000 | 46 000 | 3 | 57 000 | 44 000 | 2 | |
| 7079-T652 | Up thru 2.000 | 72 000 | 63 000 | 9 | 71 000 | 61 000 | 5 | --- | --- | - | MIL-A-22771C QQ-A-367g |
| | 2.001-3.000 | 72 000 | 62 000 | 9 | 70 000 | 60 000 | 5 | 67 000 | 55 000 | 3 | |
| | 3.001-4.000 | 71 000 | 61 000 | 9 | 70 000 | 59 000 | 5 | 67 000 | 55 000 | 3 | |
| | 4.001-5.000 | 70 000 | 60 000 | 9 | 69 000 | 58 000 | 4 | 66 000 | 54 000 | 3 | |
| | 5.001-6.000 | 69 000 | 59 000 | 9 | 68 000 | 56 000 | 4 | 66 000 | 53 000 | 3 | |

† Maximum cross-sectional area of 256 sq. in.
* Offset equals 0.2 per cent.

### TABLE VII

**RATIOS AMONG THE TENSILE, COMPRESSIVE, SHEAR AND BEARING PROPERTIES OF STRESS-RELIEVED ALUMINUM ALLOY HAND FORGINGS (F33615-68-C-1385)**

| ALLOY AND TEMPER | SAMPLE CROSS SECT. SIZE, IN. | SAMPLE NUMBER | CYS(L)/TYS(L) | CYS(LT)/TYS(LT) | CYS(ST)/TYS(ST) | SS(L)/TS(LT) | SS(LT)/TS(LT) | SS(ST)/TS(LT) | EDGEWISE BS(L)/TS(LT) e/D=1.5 | BS(L)/TS(LT) e/D=2.0 | BYS(L)/TYS(LT) e/D=1.5 | BYS(L)/TYS(LT) e/D=2.0 | BS(LT)/TS(LT) e/D=1.5 | BS(LT)/TS(LT) e/D=2.0 | BYS(LT)/TYS(LT) e/D=1.5 | BYS(LT)/TYS(LT) e/D=2.0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2014-T652 | 2X 8 | 341007 | 1.04 | 1.08 | 1.12 | 0.62 | 0.61 | --- | 1.41 | 1.71 | 1.35 | 1.56 | 1.41 | 1.81 | 1.38 | 1.54 |
| | 3X12 | 341008 | 1.03 | 1.07 | 1.12 | 0.59 | 0.59 | 0.58 | 1.44 | 1.87 | 1.38 | 1.65 | 1.37 | 1.78 | 1.36 | 1.66 |
| | 4X 8 | 341009 | 1.03 | 1.03 | 1.17 | 0.58 | 0.58 | 0.57 | 1.28 | 1.77 | 1.36 | 1.63 | 1.30 | 1.74 | 1.38 | 1.62 |
| | 4X16 | 341010 | 0.98 | 1.04 | 1.08 | 0.58 | 0.58 | 0.58 | 1.60 | 1.86 | 1.46 | 1.65 | 1.53 | 1.73 | 1.45 | 1.59 |
| | 5X 5 | 341011 | 1.03 | 1.02 | 1.13 | 0.62 | 0.60 | 0.61 | 1.31 | 1.74 | 1.40 | 1.65 | 1.29 | 1.75 | 1.40 | 1.64 |
| | 5X10 | 341012 | 1.02 | 1.02 | 1.14 | 0.60 | 0.60 | 0.57 | 1.39 | 1.74 | 1.37 | 1.57 | 1.32 | 1.83 | 1.39 | 1.64 |
| | 5X20 | 341013 | 1.01 | 1.11 | 1.12 | 0.60 | 0.59 | 0.58 | 1.39 | 1.75 | 1.38 | 1.65 | 1.34 | 1.82 | 1.38 | 1.65 |
| | 6X 6 | 341014 | 1.03 | 1.02 | 1.18 | 0.65 | 0.63 | 0.62 | 1.50 | 1.76 | 1.46 | 1.64 | 1.38 | 1.87 | 1.41 | 1.70 |
| | 6X12 | 341015 | 1.01 | 1.06 | 1.12 | 0.63 | 0.60 | 0.60 | 1.42 | 1.87 | 1.40 | 1.64 | 1.37 | 1.85 | 1.38 | 1.69 |
| | 6X24 | 341016 | 1.04 | 1.08 | 1.10 | 0.64 | 0.58 | 0.59 | 1.34 | 1.77 | 1.41 | 1.73 | 1.30 | 1.77 | 1.39 | 1.71 |
| 2024-T852 | 2X 8 | 341017 | 1.09 | 1.14 | 1.17 | 0.59 | 0.58 | --- | 1.35 | 1.84 | 1.50 | 1.82 | 1.31 | 1.74 | 1.40 | 1.79 |
| | 3X12 | 341018 | 1.05 | 1.10 | 1.12 | 0.58 | 0.57 | 0.55 | 1.29 | 1.67 | 1.36 | 1.58 | 1.28 | 1.71 | 1.34 | 1.64 |
| | 4X 8 | 341019 | 1.02 | 1.01 | 1.15 | 0.58 | 0.56 | 0.55 | 1.30 | 1.67 | 1.31 | 1.59 | 1.26 | 1.70 | 1.31 | 1.60 |
| | 4X16 | 341020 | 1.02 | 1.10 | 1.15 | 0.58 | 0.57 | 0.56 | 1.30 | 1.74 | 1.34 | 1.61 | 1.29 | 1.79 | 1.39 | 1.66 |
| | 5X 5 | 341021 | 1.02 | 1.02 | 1.15 | 0.60 | 0.59 | 0.58 | 1.37 | 1.83 | 1.45 | 1.69 | 1.30 | 1.78 | 1.36 | 1.63 |
| | 5X10 | 341022 | 1.03 | 1.05 | 1.14 | 0.58 | 0.57 | 0.56 | 1.29 | 1.65 | 1.43 | 1.57 | 1.29 | 1.74 | 1.38 | 1.62 |
| | 5X20 | 341023 | 1.05 | 1.07 | 1.09 | 0.62 | 0.61 | 0.59 | 1.33 | 1.79 | 1.40 | 1.67 | 1.35 | 1.83 | 1.46 | 1.73 |
| | 6X 6 | 341024 | 1.03 | 1.01 | 1.16 | 0.60 | 0.59 | 0.58 | 1.39 | 1.80 | 1.48 | 1.69 | 1.34 | 1.79 | 1.43 | 1.69 |
| | 6X12 | 341025 | 1.02 | 1.06 | 1.14 | 0.59 | 0.57 | 0.56 | 1.26 | 1.74 | 1.37 | 1.67 | 1.27 | 1.68 | 1.35 | 1.59 |
| | 6X24 | 341026 | 1.00 | 0.99 | 1.08 | 0.57 | 0.55 | 0.53 | 1.24 | 1.71 | 1.39 | 1.54 | 1.29 | 1.51 | 1.38 | 1.57 |
| 7075-T7352 | 2X 8 | 341027 | 1.06 | 1.05 | 1.12 | 0.62 | 0.59 | --- | 1.49 | 1.96 | 1.44 | 1.70 | 1.48 | 1.95 | 1.42 | 1.63 |
| | 3X12 | 341028 | 1.01 | 1.10 | 1.14 | 0.59 | 0.60 | 0.60 | 1.44 | 1.91 | 1.50 | 1.75 | 1.38 | 1.89 | 1.51 | 1.86 |
| | 4X 8 | 341029 | 1.05 | 1.09 | 1.14 | 0.61 | 0.59 | 0.59 | 1.46 | 2.00 | 1.58 | 1.86 | 1.51 | 1.95 | 1.54 | 1.87 |
| | 4X16 | 341030 | 1.00 | 1.08 | 1.12 | 0.60 | 0.60 | 0.58 | 1.41 | 1.86 | 1.50 | 1.73 | 1.39 | 1.86 | 1.50 | 1.80 |
| | 5X 5 | 341031 | 1.05 | 1.03 | 1.15 | 0.62 | 0.60 | 0.62 | 1.55 | 1.96 | 1.53 | 1.79 | 1.46 | 1.96 | 1.51 | 1.83 |
| | 5X10 | 341032 | 1.01 | 1.05 | 1.17 | 0.62 | 0.60 | 0.62 | 1.50 | 1.95 | 1.60 | 1.79 | 1.53 | 1.98 | 1.56 | 1.89 |
| | 5X20 | 341033 | 1.00 | 1.07 | 1.11 | 0.61 | 0.60 | 0.59 | 1.47 | 1.88 | 1.51 | 1.76 | 1.43 | 1.86 | 1.52 | 1.83 |
| | 6X 6 | 341034 | 1.06 | 1.02 | 1.11 | 0.65 | 0.63 | 0.61 | 1.56 | 2.06 | 1.58 | 1.81 | 1.53 | 2.01 | 1.57 | 1.84 |
| | 6X12 | 341035 | 0.96 | 1.01 | 1.09 | 0.63 | 0.61 | 0.59 | 1.56 | 1.95 | 1.57 | 1.86 | 1.50 | 1.95 | 1.56 | 1.87 |
| | 6X24 | 341036 | 0.93 | 1.04 | 1.09 | 0.62 | 0.63 | 0.60 | 1.51 | 1.83 | 1.51 | 1.69 | 1.38 | 1.75 | 1.42 | 1.64 |
| 7079-T652 | 2X 8 | 341037 | 1.03 | 1.13 | 1.17 | 0.64 | 0.61 | --- | 1.51 | 2.03 | 1.53 | 1.76 | 1.53 | 1.96 | 1.51 | 1.75 |
| | 3X12 | 341038 | 1.04 | 1.08 | 1.17 | 0.61 | 0.61 | 0.60 | 1.49 | 1.95 | 1.44 | 1.72 | 1.53 | 1.96 | 1.49 | 1.74 |
| | 4X 8 | 341039 | 1.05 | 1.10 | 1.16 | 0.63 | 0.62 | 0.61 | 1.44 | 1.91 | 1.50 | 1.73 | 1.51 | 1.92 | 1.54 | 1.76 |
| | 4X16 | 341040 | 1.03 | 1.06 | 1.12 | 0.62 | 0.61 | 0.60 | 1.52 | 1.96 | 1.51 | 1.75 | 1.44 | 1.94 | 1.49 | 1.68 |
| | 5X 5 | 341041 | 1.03 | 1.06 | 1.15 | 0.66 | 0.63 | 0.64 | 1.54 | 2.05 | 1.53 | 1.73 | 1.44 | 1.97 | 1.46 | 1.71 |
| | 5X10 | 341042 | 1.01 | 1.11 | 1.18 | 0.62 | 0.62 | 0.60 | 1.46 | 1.90 | 1.48 | 1.71 | 1.46 | 1.91 | 1.53 | 1.74 |
| | 5X20 | 341043 | 1.02 | 1.07 | 1.17 | 0.63 | 0.63 | 0.60 | 1.43 | 1.65 | 1.50 | 1.73 | 1.41 | 1.87 | 1.45 | 1.72 |
| | 6X 6 | 341044 | 1.08 | 1.14 | 1.09 | 0.67 | 0.66 | 0.65 | 1.55 | 2.04 | 1.56 | 1.72 | 1.53 | 2.01 | 1.58 | 1.78 |
| | 6X12 | 341045 | 1.03 | 1.07 | 1.18 | 0.64 | 0.63 | 0.61 | 1.50 | 1.91 | 1.51 | 1.73 | 1.43 | 1.93 | 1.49 | 1.73 |
| | 6X24 | 341046 | 0.99 | 1.09 | 1.16 | 0.63 | 0.61 | 0.61 | 1.35 | 1.86 | 1.48 | 1.71 | 1.27 | 1.79 | 1.49 | 1.69 |

## TABLE VIII

## STATISTICAL ANALYSES OF RATIOS AMONG TENSILE, COMPRESSIVE, SHEAR AND EDGEWISE BEARING PROPERTIES OF STRESS-RELIEVED 2014-T652 HAND FORGINGS

(F33615-68-C-1385)

| Ratio Cell | CYS(L)/TYS(L) | CYS(LT)/TYS(LT) | CYS(ST)/TYS(ST) |
|---|---|---|---|
| 1.19 | | | |
| 1.18 | | | 1 |
| 1.17 | | | 1 |
| 1.16 | | | |
| 1.15 | | | |
| 1.14 | | | 1 |
| 1.13 | | | 1 |
| 1.12 | | | 4 |
| 1.11 | | 1 | |
| 1.10 | | | 1 |
| 1.09 | | | |
| 1.08 | | 2 | 1 |
| 1.07 | | 1 | |
| 1.06 | | 1 | |
| 1.05 | | | |
| 1.04 | 2 | [illegible] | |
| 1.03 | 4 | [illegible] | |
| 1.02 | 1 | [illegible] | |
| 1.01 | 2 | | |
| 1.00 | | | |
| 0.99 | | | |
| 0.98 | 1 | | |
| n | 10 | 10 | 10 |
| $\bar{R}$ | 1.0[illegible] | 1.05[illegible] | 1.1[illegible] |
| $\sigma_{\bar{R}}$ | 0.0[illegible]73 | 0.0[illegible] | 0.0[illegible] |
| Min $\bar{R}$ | 1.011 | 1.0[illegible] | 1.111 |

| Ratio Cell | SU(L)/TUS(LT) | SU(LT)/TUS(LT) | SU(ST)/TUS(LT) | SU(LT+ST)**/TUS(LT) |
|---|---|---|---|---|
| 0.65 | 1 | | | |
| 0.64 | 1 | | | |
| 0.63 | 1 | 1 | | 1 |
| 0.62 | 2 | | 1 | 1 |
| 0.61 | | 1 | 1 | [illegible] |
| 0.60 | [illegible] | 3 | 1 | 4 |
| 0.59 | 1 | 2 | 1 | [illegible] |
| 0.58 | 2 | 3 | [illegible] | 6 |
| 0.57 | | | 2 | 2 |
| n | 10 | 10 | 9 | 19 |
| $\bar{R}$ | 0.611 | | | 0.5[illegible] |
| $\sigma_{\bar{R}}$ | 0.0078 | | | 0.00[illegible] |
| Min $\bar{R}$ | 0.577 | | | 0.536 |

e/D=1.5

| Ratio Cell | BUS(L)/TUS(LT) | BUS(LT)/TUS(LT) | BUS(L+LT)/TUS(LT) | BYS(L)/TYS(LT) | BYS(LT)/TYS(LT) | BYS(L+LT)*/TYS(LT) |
|---|---|---|---|---|---|---|
| 1.60 | 1 | | | | | |
| 1.53 | | 1 | | | | |
| 1.52 | | | | | | |
| 1.51 | | | | | | |
| 1.50 | 1 | | | | | |
| 1.49 | | | | | | |
| 1.48 | | | | | | |
| 1.47 | | | | | | |
| 1.46 | | | | 2 | 1 | 3 |
| 1.45 | | | | | | |
| 1.44 | 1 | | | | | |
| 1.43 | | | | | | |
| 1.42 | 1 | | | | | |
| 1.41 | 1 | 1 | | 1 | 1 | 2 |
| 1.40 | | | | 2 | 1 | [illegible] |
| 1.39 | [illegible] | | | | 2 | 2 |
| 1.38 | | 1 | | 2 | 4 | [illegible] |
| 1.37 | | 2 | | 1 | | [illegible] |
| 1.36 | | | | 1 | 1 | [illegible] |
| 1.35 | | | | 1 | | 1 |
| 1.34 | 1 | 1 | | | | |
| 1.33 | | 1 | | | | |
| 1.32 | [illegible] | | | | | |
| 1.31 | | | | | | |
| 1.30 | | 2 | | | | |
| 1.29 | | 1 | | | | |
| 1.28 | 1 | | | | | |
| n | 10 | 10 | | 10 | 10 | 20 |
| $\bar{R}$ | 1.408 | 1.36[illegible] | | | | 1.395 |
| $\sigma_{\bar{R}}$ | 0.00929 | 0.00[illegible]35 | | | | 0.00[illegible]21 |
| Min $\bar{R}$ | 1.[illegible]91 | 1.3[illegible] | | | | 1.382 |

e/D=2.0

| Ratio Cell | BUS(L)/TUS(LT) | BUS(LT)/TUS(LT) | BUS(L+LT)*/TUS(LT) | BYS(L)/TYS(LT) | BYS(LT)/TYS(LT) | BYS(L+LT)*/TYS(LT) |
|---|---|---|---|---|---|---|
| 1.87 | 2 | 1 | 3 | | | |
| 1.86 | 1 | | 1 | | | |
| 1.85 | | 1 | 1 | | | |
| 1.84 | | | | | | |
| 1.83 | | 1 | 1 | | | |
| 1.82 | | 1 | 1 | | | |
| 1.81 | | 1 | 1 | | | |
| 1.80 | | | | | | |
| 1.79 | | | | | | |
| 1.78 | | 1 | 1 | | | |
| 1.77 | 2 | 1 | 3 | | | |
| 1.76 | 1 | | 1 | | | |
| 1.75 | 1 | 1 | 2 | | | |
| 1.74 | 2 | 1 | 3 | | | |
| 1.73 | | 1 | 1 | 1 | | 1 |
| 1.72 | | | | | | |
| 1.71 | 1 | | 1 | | 1 | 1 |
| 1.70 | | | | | 1 | 1 |
| 1.69 | | | | | 1 | 1 |
| 1.68 | | | | | | |
| 1.67 | | | | | | |
| 1.66 | | | | | 1 | 1 |
| 1.65 | | | | 4 | 1 | 5 |
| 1.64 | | | | 2 | 2 | 4 |
| 1.63 | | | | 1 | | 1 |
| 1.62 | | | | | 1 | 1 |
| 1.61 | | | | | | |
| 1.60 | | | | | | |
| 1.59 | | | | | 1 | 1 |
| 1.58 | | | | | | |
| 1.57 | | | | 1 | | 1 |
| 1.56 | | | | 1 | | 1 |
| 1.55 | | | | | | |
| 1.54 | | | | | 1 | 1 |
| n | 10 | 10 | 20 | 10 | 10 | 20 |
| $\bar{R}$ | | | 1.769 | | | 1.640 |
| $\sigma_{\bar{R}}$ | | | 0.0118 | | | 0.0107 |
| Min $\bar{R}$ | | | 1.766 | | | 1.621 |

* Student's "t"-test showed no significant difference between average ratios for L and LT directions and F-test showed no significant difference in variability for L and LT directions.

** Student's "t"-test showed no significant difference between average ratios for LT and ST directions and F-test showed no significant difference in variability for LT and ST directions.

TABLE IX

STATISTICAL ANALYSIS OF RATIOS AMONG TENSILE, COMPRESSIVE, SHEAR AND EDGE-WISE BEARING PROPERTIES OF STRESS-RELIEVED 2014-T652 HAND FORGINGS

(F33615-68-C-1305)

| Ratio Cell | CYS(L)/TYS(L) | CYS(LT)/TYS(LT) | CYS(ST)/TYS(ST) |
|---|---|---|---|
| 1.17 | | | 1 |
| 1.16 | | | 2 |
| 1.15 | | | 2 |
| 1.14 | | 1 | 2 |
| 1.13 | | | |
| 1.12 | | | 1 |
| 1.11 | | | |
| 1.10 | | 2 | |
| 1.09 | 1 | | 1 |
| 1.08 | | | 1 |
| 1.07 | | 1 | |
| 1.06 | | 1 | |
| 1.05 | 2 | 1 | |
| 1.04 | | | |
| 1.03 | 2 | | |
| 1.02 | 4 | 1 | |
| 1.01 | | 2 | |
| 1.00 | 1 | | |
| 0.99 | | 1 | |
| n | 10 | 10 | 10 |
| $\bar{R}$ | 1.033 | 1.055 | 1.136 |
| $\sigma_{\bar{R}}$ | [illegible]** | [illegible]** | 0.00357 |
| Min $\bar{R}$ | 1.010-1.066 | 1.011-1.121 | 1.118 |

| Ratio Cell | SUS(L)/TUS(LT) | SUS(LT)/TUS(LT) | SUS(ST)/TUS(LT) |
|---|---|---|---|
| 0.63 | | | |
| 0.62 | 1 | | |
| 0.61 | | 1 | |
| 0.60 | 2 | | |
| 0.59 | 2 | 2 | 1 |
| 0.58 | 4 | 1 | 2 |
| 0.57 | 1 | 4 | |
| 0.56 | | 1 | 3 |
| 0.55 | | 1 | 2 |
| 0.54 | | | |
| 0.53 | | | 1 |
| n | 10 | 10 | 9 |
| $\bar{R}$ | 0.589 | 0.576 | 0.552 |
| $\sigma_{\bar{R}}$ | 0.00485 | 0.00337 | 0.00623 |
| Min $\bar{R}$ | 0.580 | 0.566 | 0.551 |

e/D=1.5

| Ratio Cell | BUS(L)/TUS(LT) | BUS(LT)/TUS(LT) | BUS(L+LT)*/TUS(LT) | BYS(L)/TYS(LT) | BYS(LT)/TYS(LT) | BYS(L+LT)*/TYS(LT) |
|---|---|---|---|---|---|---|
| 1.50 | | | | 1 | | 1 |
| 1.49 | | | | | | |
| 1.48 | | | | 1 | | 1 |
| 1.47 | | | | | | |
| 1.46 | | | | | 1 | 1 |
| 1.45 | | | | 1 | | 1 |
| 1.44 | | | | | | |
| 1.43 | | | | 1 | 1 | 2 |
| 1.42 | | | | | | |
| 1.41 | | | | | | |
| 1.40 | | | | 1 | 1 | 2 |
| 1.39 | 1 | | 1 | 1 | 1 | 2 |
| 1.38 | | | | | 2 | 2 |
| 1.37 | 1 | | 1 | 1 | | 1 |
| 1.36 | | | | 1 | 2 | 3 |
| 1.35 | 1 | 1 | 2 | | 1 | 1 |
| 1.34 | | 1 | 1 | 1 | | 1 |
| 1.33 | 1 | | 1 | | | |
| 1.32 | | | | | | |
| 1.31 | | 1 | 1 | 1 | 1 | 2 |
| 1.30 | 2 | 1 | 3 | | | |
| 1.29 | 2 | 3 | 5 | | | |
| 1.28 | | 1 | 1 | | | |
| 1.27 | | 1 | 1 | | | |
| 1.26 | 1 | 1 | 2 | | | |
| 1.25 | | | | | | |
| 1.24 | 1 | | 1 | | | |
| n | 10 | 10 | 20 | 10 | 10 | 20 |
| $\bar{R}$ | | | 1.305 | | | 1.392 |
| $\sigma_{\bar{R}}$ | | | 0.00869 | | | 0.01170 |
| Min $\bar{R}$ | | | 1.290 | | | 1.372 |

e/D=2.0

| Ratio Cell | BUS(L)/TUS(LT) | BUS(LT)/TUS(LT) | BUS(L+LT)*/TUS(LT) | BYS(L)/TYS(LT) | BYS(LT)/TYS(LT) | BYS(L+LT)*/TYS(LT) |
|---|---|---|---|---|---|---|
| 1.84 | 1 | | 1 | | | |
| 1.83 | 1 | 1 | 2 | | | |
| 1.82 | | | | 1 | | 1 |
| 1.81 | | | | | | |
| 1.80 | 1 | | 1 | | | |
| 1.79 | 1 | 2 | 3 | | 1 | 1 |
| 1.78 | | 1 | 1 | | | |
| 1.77 | | | | | | |
| 1.76 | | | | | | |
| 1.75 | | | | | | |
| 1.74 | 2 | 2 | 4 | | | |
| 1.73 | | | | | 1 | 1 |
| 1.72 | | | | | | |
| 1.71 | 1 | 1 | 2 | | | |
| 1.70 | | 1 | 1 | | | |
| 1.69 | | | | 2 | 1 | 3 |
| 1.68 | | 1 | 1 | | | |
| 1.67 | 2 | | 2 | 2 | | 2 |
| 1.66 | | | | | 1 | 1 |
| 1.65 | 1 | | 1 | | | |
| 1.64 | | | | 1 | 1 | 2 |
| 1.63 | | | | | 1 | 1 |
| 1.62 | | | | | 1 | 1 |
| 1.61 | | | | 1 | | 1 |
| 1.60 | | | | | 1 | 1 |
| 1.59 | | | | 1 | 1 | 2 |
| 1.58 | | | | 1 | | 1 |
| 1.57 | | | | 1 | 1 | 2 |
| 1.51 | | 1 | 1 | | | |
| n | 10 | 10 | 20 | 10 | 10 | 20 |
| $\bar{R}$ | | | 1.735 | | | 1.652 |
| $\sigma_{\bar{R}}$ | | | 0.01749 | | | 0.01546 |
| Min $\bar{R}$ | | | 1.705 | | | 1.625 |

* Student's "t"-test showed no significant difference between average ratios for L and LT directions and "F"-test showed no significant difference in variability for L and LT directions.

** Regression analysis showed significant relationship with thickness. Value shown is $\sigma_e/\sqrt{n}$

TABLE X

STATISTICAL ANALYSES OF RATIOS AMONG TENSILE, COMPRESSIVE, SHEAR AND EDGEWISE BEARING PROPERTIES OF STRESS-RELIEVED 7075-T7352 HAND FORGINGS

(F33615-68-C-1385)

| Ratio Cell | CYS(L)/TYS(L) | CYS(LT)/TYS(LT) | CYS(ST)/TYS(ST) |
|---|---|---|---|
| 1.17 | | | 1 |
| 1.16 | | | |
| 1.15 | | | 1 |
| 1.14 | | | 2 |
| 1.13 | | | |
| 1.12 | | | 2 |
| 1.11 | | | 2 |
| 1.10 | | 1 | |
| 1.09 | | 1 | 2 |
| 1.08 | | 1 | |
| 1.07 | | 1 | |
| 1.06 | 2 | | |
| 1.05 | 2 | 2 | |
| 1.04 | | 1 | |
| 1.03 | | 1 | |
| 1.02 | | 1 | |
| 1.01 | 2 | 1 | |
| 1.00 | 2 | | |
| 0.99 | | | |
| 0.98 | | | |
| 0.97 | | | |
| 0.96 | 1 | | |
| 0.95 | | | |
| 0.94 | | | |
| 0.93 | 1 | | |
| n | 10 | 10 | 10 |
| $\bar{R}$ | 1.013 | 1.054 | 1.124 |
| $\sigma_{\bar{R}}$ | 0.01383 | 0.00957 | 0.00819 |
| Min $\bar{R}$ | 0.988 | 1.036 | 1.109 |

| Ratio Cell | SU(L)/TUS(LT) | SU(LT)/TUS(LT) | SU(ST)/TUS(LT) | SU(LT+ST)**/TUS(LT) |
|---|---|---|---|---|
| 0.65 | 1 | | | |
| 0.64 | | | | |
| 0.63 | 1 | 2 | | 2 |
| 0.62 | 4 | | 2 | 2 |
| 0.61 | 2 | 1 | 1 | 2 |
| 0.60 | 1 | 5 | 2 | 7 |
| 0.59 | 1 | 2 | 3 | 5 |
| 0.58 | | | 1 | 1 |
| n | 10 | 10 | 9 | 19 |
| $\bar{R}$ | 0.617 | | | 0.603 |
| $\sigma_{\bar{R}}$ | 0.00517 | | | 0.00329 |
| Min $\bar{R}$ | 0.607 | | | 0.597 |

| e/D=1.5 | | | | | | |
|---|---|---|---|---|---|---|
| Ratio Cell | BUS(L)/TUS(LT) | BUS(LT)/TUS(LT) | BUS(L+LT)*/TUS(LT) | BYS(L)/TYS(LT) | BYS(LT)/TYS(LT) | BYS(L+LT)*/TYS(LT) |
| 1.60 | | | | 1 | | 1 |
| 1.59 | | | | | | |
| 1.58 | | | | 2 | | 2 |
| 1.57 | | | | 1 | 1 | 2 |
| 1.56 | 2 | | 2 | | 2 | 2 |
| 1.55 | 1 | | 1 | | | |
| 1.54 | | | | | 1 | 1 |
| 1.53 | | 2 | 2 | 1 | | 1 |
| 1.52 | | | | | 1 | 1 |
| 1.51 | 1 | 1 | 2 | 2 | 2 | 4 |
| 1.50 | 1 | 1 | 2 | 2 | 1 | 3 |
| 1.49 | 1 | | 1 | | | |
| 1.48 | | 1 | 1 | | | |
| 1.47 | 1 | | 1 | | | |
| 1.46 | 1 | 1 | 2 | | | |
| 1.45 | | | | | | |
| 1.44 | 1 | | 1 | 1 | | 1 |
| 1.43 | | 1 | 1 | | | |
| 1.42 | | | | | 2 | 2 |
| 1.41 | 1 | | 1 | | | |
| 1.40 | | | | | | |
| 1.39 | | 1 | 1 | | | |
| 1.38 | | 2 | 2 | | | |
| n | 10 | 10 | 20 | 10 | 10 | 20 |
| $\bar{R}$ | | | 1.477 | | | 1.521 |
| $\sigma_{\bar{R}}$ | | | 0.01290 | | | 0.01151 |
| Min $\bar{R}$ | | | 1.455 | | | 1.501 |

| e/D=2.0 | | | | | | |
|---|---|---|---|---|---|---|
| Ratio Cell | BUS(L)/TUS(LT) | BUS(LT)/TUS(LT) | BUS(L+LT)*/TUS(LT) | BYS(L)/TYS(LT) | BYS(LT)/TYS(LT) | BYS(L+LT)*/TYS(LT) |
| 2.06 | 1 | | 1 | | | |
| 2.01 | | 1 | 1 | | | |
| 2.00 | 1 | | 1 | | | |
| 1.99 | | | | | | |
| 1.98 | | 1 | 1 | | | |
| 1.97 | | | | | | |
| 1.96 | 2 | 1 | 3 | | | |
| 1.95 | 2 | 3 | 5 | | | |
| 1.94 | | | | | | |
| 1.93 | | | | | | |
| 1.92 | | | | | | |
| 1.91 | 1 | | 1 | | | |
| 1.90 | | | | | | |
| 1.89 | | 1 | 1 | | 1 | 1 |
| 1.88 | 1 | | 1 | | | |
| 1.87 | | | | | 2 | 2 |
| 1.86 | 1 | 2 | 3 | 2 | 1 | 3 |
| 1.85 | | | | | | |
| 1.84 | | | | | 1 | 1 |
| 1.83 | 1 | | 1 | | 2 | 2 |
| 1.82 | | | | | | |
| 1.81 | | | | 1 | | 1 |
| 1.80 | | | | | 1 | 1 |
| 1.79 | | | | 2 | | 2 |
| 1.78 | | | | | | |
| 1.77 | | | | | | |
| 1.76 | | | | 1 | | 1 |
| 1.75 | | 1 | 1 | 1 | | 1 |
| 1.74 | | | | | | |
| 1.73 | | | | 1 | | 1 |
| 1.72 | | | | | | |
| 1.71 | | | | | | |
| 1.70 | | | | 1 | | 1 |
| 1.69 | | | | 1 | | 1 |
| 1.68 | | | | | | |
| 1.67 | | | | | | |
| 1.66 | | | | | | |
| 1.65 | | | | | | |
| 1.64 | | | | | 1 | 1 |
| 1.63 | | | | | 1 | 1 |
| n | 10 | 10 | 20 | 10 | 10 | 20 |
| $\bar{R}$ | | | 1.926 | | | 1.790 |
| $\sigma_{\bar{R}}$ | | | 0.01597 | | | 0.05525 |
| Min $\bar{R}$ | | | 1.898 | | | 1.694 |

* Student's "t"-test showed no significant difference between average ratios for L and LT directions and F-test showed no significant difference in variability for L and LT directions.

** Student's "t"-test showed no significant difference between average ratios for LT and ST directions and F-test showed no significant difference in variability for LT and ST directions.

TABLE XI

STATISTICAL ANALYSIS OF RATIOS AMONG TENSILE, COMPRESSIVE, SHEAR AND BEARING PROPERTIES OF STRESS-RELIEVED [illegible] FORGINGS

(F33[illegible])

| Ratio | CYS(L)/TYS(L) | CYS(LT)/TYS(LT) | CYS(ST)/TYS(ST) |
|---|---|---|---|
| [illegible] | [illegible] | [illegible] | [illegible] |
| n | 10 | 10 | 10 |
| $\bar{R}$ | 1.032 | 1.092 | 1.155 |
| $\sigma_{\bar{R}}$ | 0.00753 | 0.00900 | 0.00[illegible] |
| Min $\bar{R}$ | 1.017 | 1.075 | 1.139 |

| Ratio | SUS(L)/TUS(L) | SUS(LT)/TUS(LT) | SUS(ST)/TUS(ST) |
|---|---|---|---|
| [illegible] | [illegible] | [illegible] | [illegible] |
| n | 10 | 10 | 10 |
| $\bar{R}$ | 0.635 | 0.623 | 0.623 |
| $\sigma_{\bar{R}}$ | 0.00562 | 0.00495 | 0.00[illegible] |
| Min $\bar{R}$ | 0.624 | 0.614 | 0.6[illegible] |

| e/D=1.5 Ratio | BUS(L)/TUS(L) | BUS(LT)/TUS(LT) | BUS(L+LT)/TUS(LT)* | BYS(L)/TYS(L) | BYS(LT)/TYS(LT) | BYS(L+LT)/TYS(LT)* |
|---|---|---|---|---|---|---|
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| n | 10 | 10 | 20 | 10 | 10 | 20 |
| $\bar{R}$ | | | 1.466 | | | 1.499 |
| $\sigma_{\bar{R}}$ | | | 0.01521 | | | 0.00751 |
| Min $\bar{R}$ | | | 1.434 | | | 1.485 |

| e/D=2.0 Ratio | BUS(L)/TUS(L) | BUS(LT)/TUS(LT) | BUS(L+LT)/TUS(LT)* | BYS(L)/TYS(L) | BYS(LT)/TYS(LT) | BYS(L+LT)/TYS(LT)* |
|---|---|---|---|---|---|---|
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| n | 10 | 10 | 20 | 10 | 10 | 20 |
| $\bar{R}$ | | | 1.976 | | | 1.729 |
| $\sigma_{\bar{R}}$ | | | 0.01530 | | | 0.00536 |
| Min $\bar{R}$ | | | 1.904 | | | 1.719 |

* Student's "t"-test showed no significant difference between average ratios for L and LT directions and "F"-test showed no significant difference in variability for L and LT directions.

TABLE XII

RATIOS FOR COMPUTING DESIGN MECHANICAL PROPERTIES OF STRESS-RELIEVED 2014-T652 HAND FORGINGS

| Ratio | Thickness, in. | | | | |
| --- | --- | --- | --- | --- | --- |
| | $\leq$2.000 | 2.001-3.000 | 3.001-4.000 | 4.001-5.000 | 5.001-6.000 |
| $F_{cy}(L)/F_{ty}(L)$ | 1.011 | 1.011 | 1.011 | 1.011 | 1.011 |
| $F_{cy}(LT)/F_{ty}(LT)$ | 1.035 | 1.035 | 1.035 | 1.035 | 1.035 |
| $F_{cy}(ST)/F_{ty}(ST)$ | 1.111 | 1.111 | 1.111 | 1.111 | 1.111 |
| $F_{su}/F_{tu}(LT)$ | 0.586 | 0.586 | 0.586 | 0.586 | 0.586 |
| $F_{bru}/F_{tu}(LT)$ | | | | | |
| e/D = 1.5 | 1.357 | 1.357 | 1.357 | 1.357 | 1.357 |
| e/D = 2.0 | 1.768 | 1.768 | 1.768 | 1.768 | 1.768 |
| $F_{bry}/F_{ty}(LT)$ | | | | | |
| e/D = 1.5 | 1.382 | 1.382 | 1.382 | 1.382 | 1.382 |
| e/D = 2.0 | 1.621 | 1.621 | 1.621 | 1.621 | 1.621 |

TABLE XIII

RATIOS FOR COMPUTING DESIGN MECHANICAL PROPERTIES OF STRESS-RELIEVED 2024-T852 HAND FORGINGS

| Ratios | Thickness, in. | | | | |
|---|---|---|---|---|---|
| | $\leq$2.000 | 2.001-3.000 | 3.001-4.000 | 4.001-5.000 | 5.001-6.000 |
| $F_{cy}(L)/F_{ty}(L)$ | 1.066 | 1.052 | 1.038 | 1.024 | 1.010 |
| $F_{cy}(LT)/F_{ty}(LT)$ | 1.121 | 1.093 | 1.066 | 1.039 | 1.011 |
| $F_{cy}(ST)/F_{ty}(ST)$ | 1.118 | 1.118 | 1.118 | 1.118 | 1.118 |
| $F_{su}/F_{tu}(LT)$ | 0.551 | 0.551 | 0.551 | 0.551 | 0.551 |
| $F_{bru}/F_{tu}(LT)$ | | | | | |
| e/D = 1.5 | 1.290 | 1.290 | 1.290 | 1.290 | 1.290 |
| e/D = 2.0 | 1.705 | 1.705 | 1.705 | 1.705 | 1.705 |
| $F_{bry}/F_{ty}(LT)$ | | | | | |
| e/D = 1.5 | 1.372 | 1.372 | 1.372 | 1.372 | 1.372 |
| e/D = 2.0 | 1.625 | 1.625 | 1.625 | 1.625 | 1.625 |

TABLE XIV

RATIOS FOR COMPUTING DESIGN MECHANICAL PROPERTIES
OF STRESS-RELIEVED 7075-T7352 HAND FORGINGS

| Ratio | Thickness, in. | | | | |
|---|---|---|---|---|---|
| | $\leq$2.000 | 2.001-3.000 | 3.001-4.000 | 4.001-5.000 | 5.001-6.000 |
| $F_{cy}(L)/F_{ty}(L)$ | 0.988 | 0.988 | 0.988 | 0.988 | 0.988 |
| $F_{cy}(LT)/F_{ty}(LT)$ | 1.036 | 1.036 | 1.036 | 1.036 | 1.036 |
| $F_{cy}(ST)/F_{ty}(ST)$ | 1.109 | 1.109 | 1.109 | 1.109 | 1.109 |
| $F_{su}/F_{tu}(LT)$ | 0.597 | 0.597 | 0.597 | 0.597 | 0.597 |
| $F_{bru}/F_{tu}(LT)$ | | | | | |
| e/D=1.5 | 1.455 | 1.455 | 1.455 | 1.455 | 1.455 |
| e/D=2.0 | 1.898 | 1.898 | 1.898 | 1.898 | 1.898 |
| $F_{bry}/F_{ty}(LT)$ | | | | | |
| e/D=1.5 | 1.501 | 1.501 | 1.501 | 1.501 | 1.501 |
| e/D=2.0 | 1.694 | 1.694 | 1.694 | 1.694 | 1.694 |

TABLE XV

RATIOS FOR COMPUTING DESIGN MECHANICAL PROPERTIES OF STRESS-RELIEVED 7079-T652 HAND FORGINGS

| Ratio | Thickness, in. | | | | |
|---|---|---|---|---|---|
| | ≤2.000 | 2.001-3.000 | 3.001-4.000 | 4.001-5.000 | 5.001-6.000 |
| $F_{cy}(L)/F_{ty}(L)$ | 1.017 | 1.017 | 1.017 | 1.017 | 1.017 |
| $F_{cy}(LT)/F_{ty}(LT)$ | 1.075 | 1.075 | 1.075 | 1.075 | 1.075 |
| $F_{cy}(ST)/F_{ty}(ST)$ | 1.138 | 1.138 | 1.138 | 1.138 | 1.138 |
| $E_{su}/F_{tu}(LT)$ | 0.601 | 0.601 | 0.601 | 0.601 | 0.601 |
| $F_{bru}/F_{tu}(LT)$ | | | | | |
| e/D = 1.5 | 1.439 | 1.439 | 1.439 | 1.439 | 1.439 |
| e/D = 2.0 | 1.909 | 1.909 | 1.909 | 1.909 | 1.909 |
| $F_{bry}/F_{ty}(LT)$ | | | | | |
| e/D = 1.5 | 1.485 | 1.485 | 1.485 | 1.485 | 1.485 |
| e/D = 2.0 | 1.719 | 1.719 | 1.719 | 1.719 | 1.719 |

TABLE XVI

COMPUTED DESIGN MECHANICAL PROPERTIES OF 2014-T652 ALUMINUM ALLOY HAND FORGINGS

| Alloy | 2014 | | | | |
|---|---|---|---|---|---|
| Form | Hand Forgings† | | | | |
| Condition | T652 | | | | |
| Thickness, in. | ≤2.000 | 2.001-3.000 | 3.001-4.000 | 4.001-5.000 | 5.001-6.000 |
| Basis | S | S | S | S | S |
| **Mechanical Properties:** | | | | | |
| $F_{tu}$, ksi | | | | | |
| L | 65 | 64 | 63 | 62 | 61 |
| LT | 65 | 64 | 63 | 62 | 61 |
| ST | -- | 62 | 61 | 60 | 59 |
| $F_{ty}$, ksi | | | | | |
| L | 56 | 56 | 55 | 54 | 53 |
| LT | 56 | 55 | 55 | 54 | 53 |
| ST | -- | 52 | 51 | 50 | 50 |
| $F_{cy}$, ksi | | | | | |
| L | 56 | 56 | 55 | 54 | [illegible] |
| LT | 57(+1) | 56(+1) | 56(+1) | 55(+1) | 54([illegible]) |
| ST | -- | 57(*) | 56(*) | 55(*) | 55(*) |
| $F_{su}$, ksi | 38(-2) | 37(-2) | 37(-2) | 36(-2) | 36(-2) |
| $F_{bru}$, ksi | | | | | |
| e/D=1.5 | 88(-3) | 87(-3) | 85(-3) | 84(-3) | 83(-2) |
| e/D=2.0 | 115(-2) | 113(-2) | 111(-2) | 110(-2) | 108(-2) |
| $F_{bry}$, ksi | | | | | |
| e/D=1.5 | 77(-1) | 76(-2) | 76(-1) | 74(-2) | 73(-1) |
| e/D=2.0 | 91(+1) | 89(-1) | 89(+1) | 87(+1) | 86(+1) |
| e, per cent: | | | | | |
| L | 8 | 8 | 8 | 7 | 7 |
| LT | 3 | 3 | 3 | 2 | 2 |
| ST | - | 2 | 2 | 1 | 1 |
| E, $10^6$ psi | 10.5 | | | | |
| $E_c$, $10^6$ psi | 10.8(+0.1) | | | | |
| G, $10^6$ psi | 4.0 | | | | |

Note: Numbers in parenthesis are differences from values in MIL-HDBK-5A, February 1966.

* No values shown in MIL-HDBK-5A, February 1966

† Maximum cross-sectional area of 256 sq in.

TABLE XVII

TENTATIVE COMPUTED DESIGN MECHANICAL PROPERTIES* OF 2024-T852 ALUMINUM ALLOY HAND FORGINGS

| Alloy | 2024 | | | | |
|---|---|---|---|---|---|
| Form | Hand Forgings† | | | | |
| Condition | T852 | | | | |
| Thickness, in. | ≤ 2.000 | 2.001-3.000 | 3.001-4.000 | 4.001-5.000 | 5.001-6.000 |
| Basis | | | | | |
| Mechanical Properties: | | | | | |
| $F_{tu}$, ksi | | | | | |
| L | 64 | 64 | 64 | 62 | 60 |
| LT | 61 | 61 | 61 | 59 | 57 |
| ST | -- | 59 | 59 | 57 | 55 |
| $F_{ty}$, ksi | | | | | |
| L | 54 | 54 | 54 | 53 | 52 |
| LT | 52 | 52 | 52 | 51 | 50 |
| ST | -- | 50 | 50 | 49 | 48 |
| $F_{cy}$, ksi | | | | | |
| L | 58 | 57 | 56 | 54 | 52 |
| LT | 58 | 57 | 55 | 53 | 51 |
| ST | -- | 56 | 56 | 55 | 54 |
| $F_{su}$, ksi | 34 | 34 | 34 | 32 | 31 |
| $F_{bru}$, ksi | | | | | |
| e/D=1.5 | 79 | 79 | 79 | 76 | 73 |
| e/D=2.0 | 104 | 104 | 104 | 101 | 97 |
| $F_{bry}$, ksi | | | | | |
| e/D=1.5 | 71 | 71 | 71 | 70 | 69 |
| e/D=2.0 | 84 | 84 | 84 | 83 | 81 |
| e, per cent: | | | | | |
| L | 4 | 4 | 4 | 4 | 4 |
| LT | 2 | 2 | 2 | 2 | 2 |
| ST | - | 1 | 1 | 1 | 1 |
| E, $10^6$ psi | 10.5 | | | | |
| $E_c$, $10^6$ psi | 10.8 | | | | |
| G, $10^6$ psi | 4.0 | | | | |

* No values shown in MIL-HDBK-5A, February 1966.
† Maximum cross-sectional area of 256 sq in.

TABLE XVIII

COMPUTED DESIGN MECHANICAL PROPERTIES* OF 7075-T7352 ALUMINUM ALLOY HAND FORGINGS

| Alloy | 7075 | | | | |
|---|---|---|---|---|---|
| Form | Hand Forgings† | | | | |
| Condition | T7352 | | | | |
| Thickness, in. | ≤ 2.000 | 2.001-3.000 | 3.001-4.000 | 4.001-5.000 | 5.001-6.000 |
| Basis | S | S | S | S | S |
| **Mechanical Properties:** | | | | | |
| $F_{tu}$, ksi | | | | | |
| L | 66 | 66 | 64 | 62 | 61 |
| LT | 64 | 64 | 63 | 61 | 59 |
| ST | -- | 61 | 61 | 58 | 57 |
| $F_{ty}$, ksi | | | | | |
| L | 54 | 54 | 53 | 51 | 49 |
| LT | 52 | 52 | 50 | 48 | 46 |
| ST | -- | 50 | 48 | 46 | 44 |
| $F_{cy}$, ksi | | | | | |
| L | 53 | 53 | 52 | 50 | 48 |
| LT | 54 | 54 | 52 | 50 | 48 |
| ST | -- | 55 | 53 | 51 | 49 |
| $F_{su}$, ksi | 38 | 38 | 37 | 36 | 35 |
| $F_{bru}$, ksi | | | | | |
| e/D=1.5 | 93 | 93 | 92 | 89 | 86 |
| e/D=2.0 | 121 | 121 | 119 | 116 | 112 |
| $F_{bry}$, ksi | | | | | |
| e/D=1.5 | 78 | 78 | 75 | 72 | 69 |
| e/D=2.0 | 88 | 88 | 84 | 81 | 78 |
| e, per cent: | | | | | |
| L | 7 | 7 | 7 | 7 | 6 |
| LT | 4 | 4 | 3 | 3 | 3 |
| ST | - | 3 | 2 | 2 | 2 |
| E, $10^6$ psi | 10.0 | | | | |
| $E_c$, $10^6$ psi | 10.4 | | | | |
| G, $10^6$ psi | 3.8 | | | | |

* No values in MIL-HDBK-5A, February 1966.

† Maximum cross-sectional area of 256 sq in.

TABLE XIX

COMPUTED DESIGN MECHANICAL PROPERTIES OF 7079-T652 ALUMINUM ALLOY HAND FORGINGS

| Alloy | 7079 | | | | |
|---|---|---|---|---|---|
| Form | Hand Forgings† | | | | |
| Condition | T652 | | | | |
| Thickness, in. | ≤2.000 | 2,001-3,000 | 3,001-4,000 | 4,001-5,000 | 5,001-6,000 |
| Basis | S | S | S | S | S |
| Mechanical Properties: | | | | | |
| $F_{tu}$, ksi | | | | | |
| L | 72 | 72 | 71 | 70 | 69 |
| LT | 71 | 70 | 70 | 69 | 68 |
| ST | -- | 67 | 67 | 66 | 66 |
| $F_{ty}$, ksi | | | | | |
| L | 63 | 62 | 61 | 60 | 59 |
| LT | 61 | 60 | 59 | 58 | 56 |
| ST | -- | 55 | 55 | 54 | 53 |
| $F_{cy}$, ksi | | | | | |
| L | 64(-2) | 63(-2) | 62(-2) | 61(-2) | 60(-2) |
| LT | 65(*) | 64(*) | 63(*) | 62(*) | 60(*) |
| ST | -- | 62(*) | 62(*) | 61(*) | 60(*) |
| $F_{su}$, ksi | 43 | 42(-1) | 42(-1) | 41(-1) | 41 |
| $F_{bru}$, ksi | | | | | |
| e/D=1.5 | 102(*) | 100(*) | 100(*) | 99(*) | 98(*) |
| e/D=2.0 | 135(*) | 133(*) | 133(*) | 132(*) | 130(*) |
| $F_{bry}$, ksi | | | | | |
| e/D=1.5 | 90(*) | 89(*) | 87(*) | 86(*) | 83(*) |
| e/D=2.0 | 105(*) | 103(*) | 101(*) | 99(*) | 96(*) |
| e, per cent: | | | | | |
| L | 9 | 9 | 9 | 9 | 9 |
| LT | 5 | 5 | 5 | 4 | 4 |
| ST | - | 3 | 3 | 3 | 3 |
| E, $10^6$ psi | 10.0(-0.3) | | | | |
| $E_c$, $10^6$ psi | 10.4(-0.1) | | | | |
| G, $10^6$ psi | 3.8(-0.1) | | | | |

Note: Numbers in parenthesis are differences from values in MIL-HDBK-5A, February 1966.

* No values shown in MIL-HDBK-5A, February 1966
† Maximum cross-sectional area of 256 sq in.

TABLE XX

RESULTS OF TENSILE AND COMPRESSIVE STRESS-STRAIN AND MODULUS OF ELASTICITY TESTS

(F33615-68-C-129[illegible])

**Longitudinal**

| Alloy and Temper | Sample Size, in. | Sample Number | Tensile Ultimate Stress, psi | Tensile Yield Stress,* psi | Tensile Elongation in 2 in. or 4D, % | Tensile Modulus, $10^6$ psi | Compressive Yield Stress,* psi | Compressive Modulus, $10^6$ psi |
|---|---|---|---|---|---|---|---|---|
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | 10.[illegible] | 10.3[illegible] | 68 5[illegible]0 | 10.6[illegible] |
| | 4x8 | [illegible] | [illegible] | [illegible] | 10.[illegible] | 10.41 | [illegible] | [illegible] |
| | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | 10.41 | [illegible] | [illegible] |
| | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | 10.[illegible] | [illegible] | [illegible] |
| | 5x[illegible] | [illegible] | [illegible] | [illegible] | [illegible] | 10.4[illegible] | [illegible] | [illegible] |
| [illegible] | 2x[illegible] | [illegible] | [illegible] | [illegible] | [illegible] | 10.3[illegible] | 70 1[illegible]0 | [illegible] |
| | 4x[illegible] | [illegible] | [illegible] | [illegible] | [illegible] | 10.[illegible] | [illegible] | [illegible] |
| | [illegible] | [illegible] | [illegible] | [illegible] | 9.0 | 10.50 | [illegible] | [illegible] |
| | [illegible] | [illegible] | [illegible] | [illegible] | 5.0 | 10.[illegible] | [illegible] | [illegible] |
| | [illegible] | [illegible] | [illegible] | [illegible] | 9.[illegible] | 10.41 | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | 14.5 | 10.[illegible] | [illegible] | [illegible] |
| | 4x5 | [illegible] | [illegible] | [illegible] | 14.0 | 10.[illegible] | [illegible] | [illegible] |
| | [illegible] | [illegible] | [illegible] | [illegible] | 14.0 | 9.[illegible] | [illegible] | [illegible] |
| | [illegible] | [illegible] | 64 [illegible] | [illegible] | [illegible] | 9.[illegible] | [illegible] | [illegible] |
| | 5x[illegible] | [illegible] | [illegible] | [illegible] | [illegible] | 10.18 | [illegible] | [illegible] |
| [illegible] | 2x8 | [illegible] | [illegible] | [illegible] | [illegible] | 9.91 | [illegible] | 10.[illegible] |
| | 4x8 | [illegible] | [illegible] | [illegible] | [illegible]0 | [illegible] | [illegible] | [illegible] |
| | 5x8 | [illegible] | [illegible] | [illegible] | 11.0 | [illegible] | [illegible] | [illegible] |
| | 5x20 | [illegible] | [illegible] | [illegible] | 15.[illegible] | 9.[illegible] | [illegible] | [illegible] |
| | 6x12 | [illegible] | 75 [illegible] | [illegible] | [illegible] | 10.[illegible] | [illegible] | [illegible] |

**Long-Transverse**

| Alloy and Temper | Sample Size, in. | Tensile Ultimate Stress, psi | Tensile Yield Stress,* psi | Tensile Elongation in 2 in. or 4D, % | Tensile Modulus, $10^6$ psi | Compressive Yield Stress,* psi | Compressive Modulus, $10^6$ psi |
|---|---|---|---|---|---|---|---|
| [illegible] | [illegible] | [illegible] | [illegible] | 7.0 | 10.51 | [illegible] | 11.00 |
| | 4x8 | [illegible] | [illegible] | 5.0 | 10.38 | [illegible] | 10.78 |
| | [illegible] | [illegible] | [illegible] | 7.0 | 10.41 | 64 100 | 10.7[illegible] |
| | [illegible] | [illegible] | [illegible] | [illegible] | 10.70 | [illegible] | 10.9[illegible] |
| | 5x[illegible] | [illegible] | [illegible] | 4.0 | 10.4[illegible] | [illegible] | 10.9[illegible] |
| [illegible] | 2x[illegible] | [illegible] | [illegible] | 7.0 | 10.49 | 64 100 | 10.8[illegible] |
| | 4x[illegible] | [illegible] | 68 [illegible] | 5.5 | 10.36 | 60 500 | [illegible] |
| | [illegible] | [illegible] | 61 [illegible] | [illegible] | 10.44 | [illegible] | 10.69 |
| | [illegible] | [illegible] | [illegible] | [illegible] | 10.65 | [illegible] | [illegible] |
| | [illegible] | [illegible] | [illegible] | 2.0 | 10.5[illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | 12.[illegible] | 10.17 | [illegible] | [illegible] |
| | 4x5 | [illegible] | [illegible] | 9.0 | 10.30 | [illegible] | 10.40 |
| | [illegible] | [illegible] | [illegible] | [illegible] | 9.[illegible] | [illegible] | [illegible] |
| | [illegible] | [illegible] | [illegible] | 13.0 | 10.13 | [illegible] | 10.6[illegible] |
| | 5x[illegible] | [illegible] | [illegible] | 11.0 | 10.2[illegible] | [illegible] | [illegible] |
| [illegible] | 2x8 | [illegible] | [illegible] | 10.0 | 9.94 | [illegible] 100 | 10.60 |
| | 4x8 | [illegible] | [illegible] | 9.5 | 9.[illegible] | [illegible] 200 | [illegible] |
| | 5x8 | [illegible] | [illegible] | [illegible] | 9.9[illegible] | [illegible] | [illegible] |
| | 5x20 | [illegible] | [illegible] | 10.[illegible] | 10.0[illegible] | [illegible] | [illegible] |
| | 6x12 | [illegible] | [illegible] | 8.0 | [illegible] | [illegible] | 10.18 |

**Short-Transverse**

| Alloy and Temper | Sample Size, in. | Tensile Ultimate Stress, psi | Tensile Yield Stress,* psi | Tensile Elongation in 2 in. or 4D, % | Tensile Modulus, $10^6$ psi | Compressive Yield Stress,* psi | Compressive Modulus, $10^6$ psi |
|---|---|---|---|---|---|---|---|
| [illegible] | [illegible] | -- | -- | -- | -- | -- | -- |
| | 4x8 | -- | -- | -- | -- | -- | -- |
| | [illegible] | [illegible]5 000 | 57 [illegible]00 | 3.0 | 10.3[illegible] | 66 4[illegible]0 | 10.54 |
| | [illegible] | 64 500 | 55 200 | 4.0 | 10.4[illegible] | [illegible] 500 | 10.95 |
| | 5x[illegible] | 62 100 | 53 900 | 3.0 | 10.42 | [illegible] 100 | 10.82 |
| [illegible] | 2x[illegible] | -- | -- | -- | -- | -- | -- |
| | 4x[illegible] | -- | -- | -- | -- | -- | -- |
| | [illegible] | 67 000 | 58 [illegible]00 | [illegible] | 10.40 | [illegible] | 10.58 |
| | [illegible] | [illegible] | [illegible] | 3.0 | 10.[illegible] | [illegible] | 10.82 |
| | [illegible] | 64 [illegible]00 | [illegible] | 2.5 | 10.41 | 63 600 | 10.[illegible] |
| [illegible] | [illegible] | -- | - | -- | -- | -- | -- |
| | 4x5 | -- | -- | -- | -- | -- | -- |
| | [illegible] | 61 [illegible] | 52 400 | 2.0 | 9.9[illegible] | [illegible] | 10.30 |
| | [illegible] | [illegible] | 47 [illegible]00 | [illegible] | 10.1[illegible] | [illegible] | 10.41 |
| | 5x[illegible] | [illegible] | [illegible]00 | 8.5 | 10.[illegible] | 64 400 | 10.[illegible] |
| [illegible] | 2x8 | -- | -- | -- | -- | -- | -- |
| | 4x8 | - | -- | -- | -- | -- | -- |
| | 5x8 | [illegible] | [illegible] | 8.5 | 10.[illegible] | [illegible] 100 | 10.[illegible] |
| | 5x20 | [illegible] 900 | [illegible] | 6.0 | 10.[illegible] | 68 200 | 10.[illegible] |
| | 6x12 | [illegible] | [illegible] | 4.0 | 9.[illegible] | [illegible] 200 | 10.4[illegible] |

*Offset equals 0.2 per cent.

TABLE IX

RESULTS OF TENSILE AND COMPRESSIVE STRESS-STRAIN AND MODULUS OF ELASTICITY TESTS

(F33615-68-C-1395)

| Alloy and Temper | Sample Size, in. | [illegible] | Longitudinal Tensile Ultimate Stress, psi | Longitudinal Tensile Yield Stress,* psi | Longitudinal Tensile Elongation in 2 in. or 4D, % | Longitudinal Tensile Modulus, $10^6$ psi | Longitudinal Compressive Yield Stress,* psi | Longitudinal Compressive Modulus, $10^6$ psi | Long-Transverse Tensile Ultimate Stress, psi | Long-Transverse Tensile Yield Stress,* psi | Long-Transverse Tensile Elongation in 2 in. or 4D, % | Long-Transverse Tensile Modulus, $10^6$ psi | Long-Transverse Compressive Yield Stress,* psi | Long-Transverse Compressive Modulus, $10^6$ psi | Short-Transverse Tensile Ultimate Stress, psi | Short-Transverse Tensile Yield Stress,* psi | Short-Transverse Tensile Elongation in 2 in. or 4D, % | Short-Transverse Tensile Modulus, $10^6$ psi | Short-Transverse Compressive Yield Stress,* psi | Short-Transverse Compressive Modulus, $10^6$ psi |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2014-T651 | [illegible] | [illegible] | [illegible] | 63 300 | 10.5 | 10.32 | 68 500 | 10.68 | 69 200 | 63 700 | 7.0 | 10.41 | 66 800 | 11.00 | -- | -- | -- | -- | -- | -- |
| | [illegible] | [illegible] | [illegible] | 63 600 | 10.5 | 10.41 | 65 500 | 10.77 | 69 300 | 62 700 | 5.0 | 10.36 | 69 500 | 10.78 | -- | -- | -- | -- | -- | -- |
| | [illegible] | [illegible] | [illegible] | 62 700 | 11.0 | 10.41 | 65 800 | 10.85 | 66 900 | 61 100 | 7.0 | 10.61 | 64 100 | 10.75 | 65 000 | 57 700 | 3.3 | 10.77 | 66 400 | 10.66 |
| | [illegible] | [illegible] | [illegible] | 59 700 | 11.0 | 10.37 | 63 900 | 10.65 | 65 300 | 59 100 | 4.5 | 10.70 | 63 900 | 10.91 | 64 400 | 55 200 | 6.0 | 10.6 | 63 800 | 10.66 |
| | [illegible] | [illegible] | [illegible] | 63 400 | 10.0 | 10.67 | 61 300 | 10.76 | 62 600 | 57 900 | 6.0 | 10.67 | 62 400 | 10.97 | 62 100 | 53 900 | 7.0 | 10.49 | 63 200 | 10.82 |
| 2024-T851 | [illegible] | [illegible] | [illegible] | [illegible] | 5.5 | 10.33 | 75 100 | 10.62 | 76 600 | 73 200 | 7.0 | 10.49 | 64 100 | 10.85 | -- | -- | -- | -- | -- | -- |
| | [illegible] | [illegible] | [illegible] | [illegible] | 7.5 | 10.58 | 62 200 | 10.65 | 79 800 | 68 200 | 5.5 | 10.38 | 60 600 | 10.75 | -- | -- | -- | -- | -- | -- |
| | [illegible] | [illegible] | [illegible] | [illegible] | 9.5 | 10.43 | 64 400 | 10.76 | 64 500 | 61 100 | 9.5 | 10.64 | 62 100 | 10.69 | 67 600 | 58 100 | 3.4 | 10.00 | 67 700 | 10.65 |
| | [illegible] | [illegible] | [illegible] | [illegible] | 9.5 | 10.42 | 56 200 | 10.52 | 61 100 | 56 900 | 3.0 | 10.65 | 63 600 | 10.97 | 61 900 | 55 900 | 1.0 | 10.31 | 60 700 | 10.49 |
| | [illegible] | [illegible] | [illegible] | [illegible] | 9.0 | 10.41 | 53 100 | 10.65 | 44 300 | 53 400 | 3.0 | 10.55 | [illegible] | [illegible] | 54 200 | 46 500 | 2.5 | 10.41 | 43 600 | 10.74 |
| 7075-T7351 | [illegible] | [illegible] | [illegible] | [illegible] | 14.5 | 10.31 | 63 500 | 10.34 | 70 200 | 64 300 | 12.0 | 10.17 | 73 900 | 10.76 | -- | -- | -- | -- | -- | -- |
| | [illegible] | [illegible] | [illegible] | [illegible] | 14.3 | 10.27 | 53 900 | 10.64 | 66 100 | 56 300 | 9.5 | 10.10 | 68 300 | 10.69 | -- | -- | -- | -- | -- | -- |
| | [illegible] | [illegible] | 65 450 | [illegible] | 14.3 | 9.94 | 63 400 | 10.61 | 66 900 | 45 800 | 2.5 | 9.95 | 66 100 | 10.67 | 61 300 | 58 400 | 9.0 | 9.99 | 59 300 | 10.40 |
| | [illegible] | [illegible] | 64 200 | [illegible] | 12.5 | 9.97 | 62 500 | 10.13 | 66 100 | 43 100 | 13.0 | 10.13 | 55 700 | 10.58 | 62 000 | 45 700 | 7.0 | 10.15 | 66 300 | 10.61 |
| | [illegible] | [illegible] | [illegible] | [illegible] | 12.5 | 10.16 | 51 600 | 10.17 | 60 100 | 40 200 | 11.5 | 10.25 | 51 100 | 10.56 | 63 800 | 47 100 | 8.5 | 10.20 | 64 400 | 10.62 |
| 7079-T651 | [illegible] | [illegible] | [illegible] | [illegible] | 17.7 | 9.91 | [illegible] | 10.36 | 78 300 | 64 600 | 10.0 | 9.36 | 79 100 | 10.62 | -- | -- | -- | -- | -- | -- |
| | [illegible] | [illegible] | [illegible] | [illegible] | 11.0 | 9.59 | [illegible] | 10.36 | 74 700 | 47 000 | 9.9 | 9.59 | [illegible] | 10.23 | -- | -- | -- | -- | -- | -- |
| | [illegible] | [illegible] | [illegible] | 65 650 | 11.5 | 9.58 | 63 700 | 10.35 | 71 600 | 61 100 | 7.5 | 9.64 | [illegible] | [illegible] | [illegible] | [illegible] | 8.5 | 10.08 | [illegible] | 10.19 |
| | [illegible] | [illegible] | [illegible] | [illegible] | 16.4 | 9.58 | 61 200 | 10.13 | 72 600 | 61 500 | 10.5 | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | 8.0 | 10.01 | [illegible] | 10.31 |
| | [illegible] | [illegible] | [illegible] | 65 630 | 13.3 | 10.34 | 65 600 | 10.11 | 73 300 | 61 500 | 6.0 | 9.9 | 64 600 | 10.36 | [illegible] | [illegible] | 6.0 | 9.96 | 71 300 | 10.61 |

*Offset equals 0.2 per cent.

TABLE XXI

AVERAGE* MODULUS VALUES OF 2 TO 6-IN. THICK STRESS-RELIEVED ALUMINUM ALLOY HAND FORGINGS

(F33615-68-C-1385)

| Alloy and Temper | Average Modulus of Elasticity Values, $10^6$ psi | | | | | |
|---|---|---|---|---|---|---|
| | Tension | | | Compression | | |
| | Longitudinal | Long-Transverse | Short-Transverse | Longitudinal | Long-Transverse | Short-Transverse |
| 2014-T652 | 10.40 | 10.49 | 10.40 | 10.74 | 10.89 | 10.77 |
| 2024-T352 | 10.49 | 10.50 | 10.45 | 10.75 | 10.79 | 10.75 |
| 7075-T7352 | 10.04 | 10.13 | 10.11 | 10.37 | 10.55 | 10.48 |
| 7079-T652 | 9.94 | 9.96 | 10.00 | 10.30 | 10.36 | 10.35 |
| Averages | | | | | | |
| 2014 and 2024 | 10.44 | 10.50 | 10.42 | 10.74 | 10.84 | 10.76 |
| 7075 and 7079 | 9.99 | 10.04 | 10.06 | 10.34 | 10.46 | 10.42 |

AVERAGES,† ALL DIRECTIONS

| Series | Modulus, psi | |
|---|---|---|
| | Tension | Compression |
| 2000 | 10 500 000 | 10 800 000 |
| 7000 | 10 000 000 | 10 400 000 |

* For each L and LT - 5 samples; for ST - 3 samples.
† Values rounded to nearest 100 000 psi.

TABLE XXII

RESULTS OF NOTCH-BEND FRACTURE TOUGHNESS TESTS
OF STRESS-RELIEVED ALUMINUM ALLOY HAND FORGINGS

(F33615-68-C-1365)

| Sample: Alloy and Temper | Sample: Cross Sect. Size, in. | Sample: Number | Specimen: Direction* and Number | Specimen: Type See Fig. 5 | Specimen: Width (W), in. | Specimen: Thickness (B), in. | Fatigue Pre-Cracking†: Max. Load (P), lb | Fatigue Pre-Cracking†: Max. Stress Intensity, $K_f$, psi$\sqrt{in.}$ | Fatigue Pre-Cracking†: Cycles | Fatigue Pre-Cracking†: Crack Length‡ (a), in. | At 5 Per Cent Secant Offset: Load§ ($P_Q$), lb | At 5 Per Cent Secant Offset: $K_Q$,** psi$\sqrt{in.}$ | At 5 Per Cent Secant Offset: Minimum Thickness, $2.5(\frac{K_Q}{\sigma_{ys}})^2$, in. | Meaningful $K_{Ic}$ | Fracture Appearance % Oblique |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2014-T652 | 2x8 | 341307 | LW1 | 3 | 1.501 | 0.7501 | 251 | 5 400 | 156 000 | 0.688 | 2 450 | 24 930 | 0.352 | Yes | 35 |
| | | | 2 | | 1.500 | 0.7510 | 251 | 6 200 | 159 000 | 0.752 | 2 320 | 26 900 | 0.410 | Yes | 35 |
| | | | 3 | | 1.500 | 0.7523 | 251 | 5 900 | 126 000 | 0.728 | 2 300 | 24 500 | 0.333 | Yes | 30 |
| | | | WL1 | 3 | Specimen failed during fatigue cracking. | | | | | | | | | | |
| | | | 2 | | 1.500 | 0.7532 | 251 | 5 800 | 283 000 | 0.777 | 1 760 | 19 300 | 0.221 | Yes | 0 |
| | | | 3 | | 1.501 | 0.7542 | 251 | 6 100 | 450 000 | 0.748 | 1 680 | 19 500 | 0.219 | Yes | 5 |
| | 3x12 | 341303 | LW1 | 4 | 2.000 | 0.9976 | 605 | 8 100 | 141 000 | 0.925 | 3 920 | 26 300 | 0.353 | Yes | 85 |
| | | | 2 | | 1.997 | 0.9976 | 605 | 8 700 | 107 000 | 0.970 | 3 670 | 26 500 | 0.400 | Yes | 25 |
| | | | 3 | | 2.001 | 1.0000 | 605 | 8 600 | 131 000 | 0.968 | 3 750 | 27 100 | 0.418 | Yes | 35 |
| | | | WL1 | 4 | 2.002 | 0.9978 | 605 | 9 500 | 68 000 | 1.030 | 2 575 | 20 300 | 0.183 | Yes | 0 |
| | | | 2 | | 1.997 | 0.9970 | 605 | 9 500 | 97 000 | 1.035 | 2 460 | 19 500 | 0.275 | Yes | 0 |
| | | | 3 | | Specimen failed during fatigue cracking. | | | | | | | | | | |
| | 4x16 | 341005 | LW1 | 5 | 3.003 | 1.5000 | 1 539 | 13 400 | 91 000 | 1.577 | 7 980 | 35 400 | 0.801 | Yes** | 2 |
| | | | 2 | | 3.002 | 1.5030 | 1 539 | 11 600 | 130 000 | 1.442 | 8 550 | 32 800 | 0.620 | Yes | 35 |
| | | | 3 | | 3.003 | 1.5020 | 1 539 | 12 100 | 100 000 | 1.465 | 8 520 | 34 100 | 0.790 | Yes | 2 |
| | | | WL1 | 5 | 3.001 | 1.5030 | 1 539 | 12 300 | [illegible] | 1.477 | 5 650 | 21 000 | 0.378 | Yes## | 0 |
| | | | 2 | | 3.002 | 1.5020 | 1 539 | 13 200 | [illegible] | [illegible] | [illegible] | 19 700 | 0.369 | Yes## | 0 |
| | | | 3 | | 3.002 | 1.5030 | 1 539 | 14 600 | [illegible] | 1.442 | [illegible] | 23 700 | 0.376 | Yes## | 0 |
| | | | TL1 | 1 | 0.500 | 0.2500 | [illegible] | [illegible] | 68 000 | 0.382 | 254 | 19 000 | 0.275 | Yes‖ | 5 |
| | | | 2 | | 0.501 | 0.2502 | [illegible] | [illegible] | 61 000 | 0.368 | 262 | 19 000 | 0.277 | Yes‖ | 5 |
| | | | 3 | | 0.500 | 0.2504 | [illegible] | [illegible] | 71 000 | 0.365 | 253 | 19 400 | 0.268 | Yes‖ | 0 |
| | 5x20 | 341013 | LW1 | 5 | 3.001 | 1.5010 | 1 539 | [illegible] | 300 000 | [illegible] | 7 400 | 30 300 | 0.650 | Yes | 20 |
| | | | 2 | | 3.001 | 1.5000 | 1 539 | [illegible] | 195 000 | [illegible] | 7 160 | 25 800 | 0.536 | Yes | 20 |
| | | | 3 | | 3.004 | 1.5000 | 1 539 | [illegible] | 205 000 | 1.530 | 6 430 | 29 800 | 0.578 | Yes | 18 |
| | | | WL1 | 5 | 3.002 | 1.5000 | 1 539 | 13 700 | 132 000 | [illegible] | 4 350 | 20 700 | 0.326 | Yes## | 5 |
| | | | 2 | | 3.004 | 1.5000 | 1 533 | 13 200 | 145 000 | [illegible] | 4 350 | 20 100 | 0.307 | Yes## | 0 |
| | | | 3 | | 3.003 | 1.5000 | 1 539 | 14 600 | 225 000 | [illegible] | 3 650 | 17 300 | 0.243 | Yes## | 0 |
| | | | TL1 | 2 | 1.000 | 0.4999 | 200 | 8 600 | 126 000 | 0.467 | 930 | 17 600 | 0.263 | Yes | 0 |
| | | | 2 | | 1.000 | 0.5005 | 200 | 8 700 | 153 000 | 0.470 | 1 015 | [illegible] | 0.307 | Yes | 0 |
| | | | 3 | | 1.000 | 0.4985 | 200 | 9 900 | 136 000 | 0.310 | 700 | 16 600 | 0.273 | Yes## | 0 |
| | 6x24 | 341016 | LW1 | 6 | 4.001 | 2.0020 | 2 308 | 13 700 | 63 000 | 2.155 | 13 400 | 43 400 | 1.506 | No | 55 |
| | | | 2 | | 4.003 | 2.0060 | 2 308 | 13 000 | 353 000 | 2.135 | 16 300 | 47 200 | 1.835 | No | 65 |
| | | | 3 | | 4.003 | 2.0040 | 2 308 | 10 100 | 320 000 | 1.615 | [illegible] | 55 700 | 2.462 | No‖ | 25 |
| | | | WL1 | 6 | 4.007 | 2.0040 | 2 308 | 13 900 | 325 000 | 2.316 | 7 500 | 28 600 | 0.369 | Yes** | 2 |
| | | | 2 | | 4.001 | 2.0050 | 2 308 | 12 600 | 500 000 | 2.023 | 8 500 | [illegible] | 0.466 | Yes** | 0 |
| | | | 3 | | 4.003 | 2.0030 | 2 308 | 11 500 | 654 000 | 1.977 | 11 350 | [illegible] | 0.665 | Yes | 2 |
| | | | TL1 | 2 | 1.002 | 0.5001 | 300 | 10 700 | 271 000 | 0.535 | 1 050 | [illegible] | 0.532 | Yes‖ | 5 |
| | | | 2 | | 1.001 | 0.5000 | 300 | 9 000 | 183 000 | 0.443 | [illegible] | [illegible] | 0.550 | Yes‖ | 10 |
| | | | 3 | | 1.001 | 0.5000 | 300 | 8 700 | 231 000 | 0.468 | [illegible] | [illegible] | [illegible] | Yes‖ | 10 |

Continued

TABLE XXII (Continued)

RESULTS OF NOTCH-BEND FRACTURE TOUGHNESS TESTS OF STRESS-RELIEVED ALUMINUM ALLOY HAND FORGINGS

(F33615-68-C-1385)

| Sample: Alloy and Temper | Sample: Cross-Sect. Size, in. | Sample: Number | Specimen: Direction and Number | Specimen: Type (See Fig. 5) | Specimen: Width (W), in. | Specimen: Thickness (B), in. | Fatigue Pre-Cracking*: Max. Load (P), lb | Fatigue Pre-Cracking*: Max. Stress Intensity, $K_f$, psi$\sqrt{in.}$ | Fatigue Pre-Cracking*: Cycles | Fatigue Pre-Cracking*: Crack Length (a), in. | At 5 Per Cent Secant Offset: Load ($P_Q$), lb | At 5 Per Cent Secant Offset: $K_Q$**, psi$\sqrt{in.}$ | At 5 Per Cent Secant Offset: Minimum Thickness, $2.5(\frac{K_Q}{\sigma_{ys}})^2$, in. | Meaningful $K_{Ic}$ | Fracture Appearance, % Oblique |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2024-T852 | 2x8 | 34,017 | LT-1 | 3 | 1.501 | 0.7516 | 251 | 5 600 | 1[illegible] 000 | 0.707 | 2 140 | 23 600 | 0.305 | Yes | 15 |
| | | | 2 | | 1.501 | 0.7506 | 251 | 6 400 | 103 000 | 0.770 | 2 150 | 25 000 | 0.405 | Yes** | 15 |
| | | | 3 | | 1.501 | 0.7516 | 251 | 5 200 | 134 000 | 0.667 | 2 500 | 26 500 | 0.355 | Yes** | 60 |
| | | | WL-1 | 3 | 1.500 | 0.7519 | 251 | 5 200 | 151 000 | 0.667 | 2 470 | 24 100 | 0.356 | Yes** | 2 |
| | | | 2 | | 1.501 | 0.7537 | 251 | 5 500 | 642 000 | 0.697 | 2 280 | 23 400 | 0.339 | Yes** | 2 |
| | | | 3 | | 1.501 | 0.7491 | 251 | 6 300 | 82 000 | 0.763 | 1 880 | 19 800 | 0.240 | Yes | 5 |
| | 3x12 | [illegible] | LT-1 | 4 | 1.997 | 0.9991 | 605 | 8 300 | 115 000 | 0.935 | 3 600 | 28 600 | 0.240 | Yes | 15 |
| | | | 2 | | 2.002 | 0.9970 | 605 | 6 500 | 174 000 | 0.960 | 3 310 | 28 600 | 0.253 | Yes | 20 |
| | | | 3 | | 2.000 | 0.9995 | 605 | 6 400 | 171 000 | 0.950 | 3 150 | 21 900 | 0.270 | Yes | 15 |
| | | | WL-1 | 4 | 2.001 | 1.0000 | 605 | 7 500 | 175 000 | 0.905 | 2 920 | 19 500 | 0.158 | Yes | 0 |
| | | | 2 | | 1.996 | 0.9994 | 605 | 9 300 | 80 000 | 1.010 | 2 175 | 15 100 | 0.162 | Yes*** | 0 |
| | | | 3 | | 2.000 | 1.0010 | 605 | 9 400 | 17 000 | 1.020 | 2 175 | 16 300 | 0.150 | Yes*** | 0 |
| | 4x16 | [illegible] | LT-1 | 5 | 3.002 | 1.5000 | 1 307 | 10 500 | 123 000 | 1.682 | 6 240 | 35 000 | 0.365 | Yes** | 10 |
| | | | 2 | | 3.001 | 1.5000 | 1 307 | 12 300 | 115 000 | 1.645 | 5 050 | [illegible] 100 | 0.450 | Yes** | 20 |
| | | | 3 | | 3.002 | 1.5000 | 1 307 | 9 400 | 178 000 | 1.643 | 7 500 | [illegible] | 0.488 | Yes | 30 |
| | | | WL-1 | 5 | 3.003 | [illegible] | 1 307 | 11 [illegible] | 65 000 | 1.605 | 3 [illegible] | 16 [illegible] | 0.157 | No*** | 0 |
| | | | 2 | | [illegible] | [illegible] | 1 307 | [illegible] | [illegible] | 1.613 | 3 [illegible] | 16 [illegible] | 0.143 | No*** | 0 |
| | | | 3 | | 3.004 | [illegible] | [illegible] | 9 500 | 389 000 | 1.635 | 3 [illegible] | 13 [illegible] | 0.116 | No*** | 0 |
| | | | TL-1 | 1 | 0.500 | 0.2495 | 45 | 7 500 | 58 000 | 0.267 | 221 | 15 000 | 0.164 | Yes | 0 |
| | | | 2 | | 0.500 | 0.2495 | 45 | 7 700 | 62 000 | 0.273 | 226 | 15 600 | 0.165 | Yes | 0 |
| | | | 3 | | 0.500 | 0.2495 | 45 | 7 100 | 74 000 | 0.258 | 254 | 16 100 | 0.170 | Yes | 5 |
| | 5x20 | [illegible] | LT-1 | 5 | 3.003 | 1.5051 | 1 307 | 9 400 | 130 000 | 1.595 | 7 500 | [illegible] 000 | 0.597 | Yes | 30 |
| | | | 2 | | 3.003 | 1.5020 | 1 307 | 9 600 | 152 000 | 1.600 | 7 110 | [illegible] 100 | 0.5[illegible] | Yes | 20 |
| | | | 3 | | 3.001 | 1.5040 | 1 307 | 10 400 | 166 000 | 1.542 | 6 620 | [illegible] 300 | 0.658 | Yes** | 15 |
| | | | WL-1 | 5 | 3.001 | 1.5000 | 1 307 | 9 700 | 146 000 | 1.422 | 4 600 | 17 300 | 0.244 | Yes*** | 0 |
| | | | 2 | | 3.002 | 1.5030 | 1 307 | 10 500 | 173 000 | 1.507 | 4 340 | 17 500 | 0.246 | Yes*** | 0 |
| | | | 3 | | 3.002 | 1.5010 | 1 307 | 11 100 | 176 000 | 1.553 | 4 660 | 17 600 | 0.240 | Yes*** | 0 |
| | | | TL-1 | 2 | 1.002 | 0.5000 | 200 | 9 500 | 145 000 | 0.513 | 685 | 15 100 | 0.193 | No*** | 0 |
| | | | 2 | | 1.002 | 0.4999 | 200 | 9 200 | 116 000 | 0.470 | 730 | 16 900 | [illegible] | Yes*** | 0 |
| | | | 3 | | 1.001 | 0.4999 | 200 | 8 500 | 139 000 | 0.473 | 810 | 15 500 | 0.2[illegible]0 | Yes*** | 0 |
| | 6x24 | [illegible] | LT-1 | 6 | 4.002 | 1.9940 | 2 300 | 11 300 | 144 000 | 1.[illegible] | 11 250 | 36 [illegible] | 0.693 | Yes | 15 |
| | | | 2 | | 4.001 | 2.0010 | 2 300 | 12 700 | 215 000 | 2.005 | 10 250 | 36 500 | 0.758 | Yes | 15 |
| | | | 3 | | 4.003 | 2.0030 | 2 300 | 13 800 | 252 000 | 2.302 | 9 800 | 36 [illegible] | 0.752 | Yes** | 10 |
| | | | WL-1 | 6 | 4.000 | 2.0040 | 1 553 | 8 400 | 718 000 | 2.170 | 7 [illegible] | 21 [illegible] | 0.2[illegible] | No*** | 0 |
| | | | 2 | | 3.998 | 2.0030 | 1 553 | 7 600 | 169 000 | 2.03[illegible] | 6 [illegible] | 17 [illegible] | 0.2[illegible] | Yes | 0 |
| | | | 3 | | 4.001 | 2.0050 | 1 553 | 7 600 | [illegible] 000 | 2.00[illegible] | 5 [illegible] | 16 [illegible] | 0.179 | Yes | 0 |
| | | | TL-1 | 2 | 1.000 | 0.5012 | 187 | 9 300 | 276 000 | 0.512 | 740 | 16 400 | 0.250 | Yes** | 0 |
| | | | 2 | | 1.001 | 0.5002 | 187 | 9 100 | 270 000 | 0.505 | 665 | 14 500 | [illegible] | Yes** | 0 |
| | | | 3 | | 1.002 | 0.5003 | 187 | 9 100 | 234 000 | 0.507 | 800 | 17 300 | 0.257 | Yes** | 0 |

Continued

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TABLE XXII (Continued)

RESULTS OF NOTCH-BEND FRACTURE TOUGHNESS TESTS
OF STRESS-RELIEVED ALUMINUM ALLOY HAND FORGINGS

(F33615-68-C-1385)

| Sample: Alloy and Temper | Sample: Cross-Sect. Size, in. | Sample: Number | Specimen: Direction* and Number | Specimen: Type See Fig. 5 | Specimen: Width(W), in. | Specimen: Thickness(B), in. | Fatigue Pre-Cracking†: Max. Load(P), lb | Fatigue Pre-Cracking†: Max. Stress Intensity, $K_f$, psi$\sqrt{in.}$ | Fatigue Pre-Cracking†: Cycles | Fatigue Pre-Cracking†: Crack Length‡ (a), in. | At 5 Per Cent Secant Offset: Load§ ($P_Q$), lb | At 5 Per Cent Secant Offset: $K_Q$, psi$\sqrt{in.}$ | At 5 Per Cent Secant Offset: Thickness, $2.5(\frac{K_Q}{\sigma_{ys}})^2$, in. | Meaningful $K_{Ic}$ | Fracture Appearance % Oblique |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7075-T7352 | 2x8 | 341027 | LW1 | 3 | 1.498 | 0.7510 | 251 | 5 800 | 98 000 | 0.722 | 2 940 | 32 200 | 0.607 | Yes | 25 |
| | | | 2 | | 1.501 | 0.7535 | 251 | 6 100 | 64 000 | 0.747 | 2 650 | 30 300 | 0.537 | Yes | 18 |
| | | | 3 | | 1.501 | 0.7515 | 251 | 6 100 | 147 000 | 0.748 | 2 750 | 31 600 | 0.586 | Yes | 25 |
| | | | WL1 | 3 | 1.501 | 0.7505 | 251 | 5 900 | 139 000 | 0.726 | 2 150 | 23 700 | 0.330 | Yes** | 10 |
| | | | 2 | | 1.499 | 0.7511 | 251 | 6 700 | 183 000 | 0.785 | 1 920 | 24 000 | 0.358 | No** | 0 |
| | | | 3 | | 1.501 | 0.7525 | 251 | 6 100 | 166 000 | 0.750 | 2 100 | 24 200 | 0.343 | Yes** | 5 |
| | 3x12 | 341028 | LW1 | 4 | 1.998 | 0.9930 | 504 | 7 100 | 116 000 | 0.965 | 4 330 | 30 500 | 0.530 | Yes | 40 |
| | | | 2 | | 2.001 | 0.9978 | 504 | 7 500 | 130 000 | 0.923 | 4 120 | 30 600 | 0.535 | Yes** | 40 |
| | | | 3 | | 1.998 | 0.9965 | 504 | 7 400 | 248 000 | 0.963 | 4 500 | 33 100 | 0.626 | Yes | 10 |
| | | | WL1 | 4 | 1.997 | 0.9980 | 605 | 10 000 | 62 000 | 1.055 | 3 280 | 27 200 | 0.524 | No** | 0 |
| | | | 2 | | 2.003 | 0.9976 | 605 | 8 500 | 91 000 | 0.992 | 3 170 | 23 500 | 0.391 | Yes | 5 |
| | | | 3 | | 1.997 | 1.0000 | 605 | 8 700 | 57 000 | 0.988 | 3 175 | 22 800 | 0.369 | Yes | 0 |
| | 4x16 | 341032 | LW1 | 5 | 3.003 | 1.5000 | 1 282 | 12 500 | 229 000 | 1.677 | 6 940 | 34 600 | 0.833 | Yes | 10 |
| | | | 2 | | 3.003 | 1.5000 | 1 282 | 11 300 | 197 000 | 1.585 | 6 960 | 31 200 | 0.687 | Yes | 7 |
| | | | 3 | | 3.003 | 1.4980 | 1 282 | 11 600 | 206 000 | 1.610 | 7 010 | 32 400 | 0.739 | Yes | 5 |
| | | | WL1 | 5 | 3.003 | 1.5000 | 1 282 | 12 900 | 266 000 | 1.702 | 5 490 | 25 200 | 0.651 | Yes** | 4 |
| | | | 2 | | 3.002 | 1.4990 | 1 282 | 13 400 | 334 000 | 1.732 | 4 670 | 24 200 | 0.562 | Yes** | 0 |
| | | | 3 | | 3.001 | 1.4990 | 1 282 | 11 500 | 189 000 | 1.598 | 5 770 | 26 300 | 0.569 | Yes | 0 |
| | | | TL1 | 1 | 0.500 | 0.2491 | 45 | 7 900 | 91 000 | 0.273 | 240 | 16 200 | 0.261 | Yes§§ | 0 |
| | | | 2 | | 0.501 | 0.2490 | 45 | 8 300 | 64 000 | 0.292 | 245 | 16 000 | 0.234 | Yes§§ | 0 |
| | | | 3 | | 0.500 | 0.2495 | 45 | 7 500 | 93 000 | 0.267 | 275 | 18 500 | 0.311 | Yes§§ | 0 |
| | 5x20 | 341033 | LW1 | 5 | 3.003 | 1.5020 | 1 307 | 11 300 | 119 000 | 1.577 | 7 900 | 35 100 | 1.119 | Yes** | 10 |
| | | | 2 | | 3.001 | 1.5030 | 1 307 | 10 500 | 123 000 | 1.507 | 8 060 | 33 200 | 1.002 | Yes | 10 |
| | | | 3 | | 3.004 | 1.4990 | 1 307 | 11 700 | 100 000 | 1.607 | 7 960 | 36 500 | 1.211 | Yes | 10 |
| | | | WL1 | 5 | 3.002 | 1.5000 | 1 307 | 10 900 | 102 000 | 1.537 | 6 720 | 28 600 | 0.754 | Yes** | 0 |
| | | | 2 | | 3.002 | 1.5000 | 1 307 | 11 100 | 100 000 | 1.553 | 6 540 | 25 300 | 0.750 | Yes** | 5 |
| | | | 3 | | 3.002 | 1.5010 | 1 307 | 10 500 | 60 000 | 1.505 | 6 600 | 27 [illegible] | 0.7[illegible] | Yes** | 5 |
| | | | TL1 | 2 | 1.001 | 0.5000 | 200 | 9 300 | 159 000 | 0.473 | 915 | 19 000 | 0.572 | Yes | 0 |
| | | | 2 | | 1.001 | 0.5000 | 200 | 8 900 | 133 000 | 0.478 | 930 | 15 600 | 0.[illegible] | Yes | 0 |
| | | | 3 | | 1.001 | 0.5000 | 200 | 8 400 | 99 000 | 0.458 | 980 | 15 300 | 0.544 | Yes | 0 |
| | 6x24 | 341036 | LW1 | 6 | 3.998 | 2.0020 | 2 500 | 14 300 | 141 000 | 2.133 | 13 300 | 39 700 | 1.666 | Yes** | 5 |
| | | | 2 | | 3.997 | 2.0020 | 2 500 | 14 900 | 87 000 | 2.160 | 12 900 | 39 300 | 1.651 | Yes** | 10 |
| | | | 3 | | 3.997 | 2.0020 | 2 500 | 15 100 | 143 000 | 2.203 | 13 100 | 41 400 | 1.814 | No* | 20 |
| | | | WL1 | 6 | 4.002 | 2.0020 | 2 500 | 13 300 | 139 000 | 2.118 | 9 500 | 27 300 | 0.859 | Yes** | 0 |
| | | | 2 | | Specimen failed during fatigue cracking. | | | | | | | | | | |
| | | | 3 | | 4.001 | 2.0050 | 2 500 | 14 600 | 275 000 | 2.173 | 9 000 | 27 600 | 0.846 | Yes** | 0 |
| | | | TL1 | §§§ | 2.004 | 1.0000 | 1 507 | 10 200 | 90 000 | 0.979 | 3 910 | 24 500 | 0.864 | Yes | 0 |
| | | | 2 | | 2.004 | 1.0000 | 1 507 | 10 600 | 100 000 | 1.027 | 3 610 | 25 400 | 0.791 | Yes | 0 |
| | | | 3 | | 2.003 | 1.0000 | 1 507 | 10 200 | 112 000 | 0.977 | 3 650 | 24 100 | 0.741 | Yes | 0 |

Continued

TABLE XXXI (Concluded)

RESULTS OF NOTCH-BEND FRACTURE TOUGHNESS TESTS OF STRESS-RELIEVED ALUMINUM ALLOY HAND FORGINGS

(F33615-68-C-1385)

| Sample: Alloy and Temper | Sample: Cross-Sect. Size, in. | Sample: Number | Specimen: Direction* and Number | Specimen: Type See Fig. 5 | Specimen: Width (W), in. | Specimen: Thickness (B), in. | Fatigue Pre-Cracking†: Max. Load (P), lb | Fatigue Pre-Cracking†: Max. Stress Intensity, $K_f$, psi√in. | Fatigue Pre-Cracking†: Cycles | Fatigue Pre-Cracking†: Crack Length‡ (a), in. | At 5 Per Cent Secant Offset: Load§ ($P_Q$), lb | At 5 Per Cent Secant Offset: $K_Q$**, psi√in. | At 5 Per Cent Secant Offset: Minimum Thickness, $2.5(K_Q/\sigma_{ys})^2$, in. | Meaningful $K_{Ic}$ | Fracture Appearance % Oblique |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7079-T652 | 2x3 | 341037 | LW1 | 3 | 1.499 | 0.7529 | 251 | 6 200 | 55 000 | 0.751 | 2 375 | 27 700 | 0.379 | Yes | 30 |
| | | | 2 | | 1.500 | 0.7501 | 251 | 6 000 | 40 000 | 0.733 | [illegible] | [illegible] | [illegible] | Yes** | 10 |
| | | | 3 | | 1.499 | 0.7509 | 251 | 7 700 | 92 000 | 0.845 | [illegible] | 32 800 | [illegible] | Yes** | 35 |
| | | | WL1 | 3 | 1.501 | 0.7505 | 295 | 8 000 | 35 000 | 0.737 | 1 970 | 24 700 | 0.361 | Yes | |
| | | | 2 | | 1.500 | 0.7502 | 295 | 10 700 | 20 000 | 0.913 | 1 655 | 27 700 | 0.654 | No*** | |
| | | | 3 | | 1.501 | 0.7500 | 295 | 9 000 | 301 300 | 0.850 | 1 950 | 26 300 | 0.473 | No*** | |
| | 3x12 | 341038 | LW1 | 4 | 2.000 | 0.9997 | 504 | 7 800 | 15 000 | 1.027 | 3 880 | 27 100 | 0.383 | Yes** | 9 |
| | | | 2 | | 2.000 | 0.9991 | 504 | 7 800 | 88 000 | 1.015 | 3 520 | 27 700 | [illegible] | Yes** | 4 |
| | | | 3 | | 2.002 | 0.9990 | 504 | 7 700 | 88 000 | 1.013 | 3 440 | 26 400 | 0.368 | No** | 2 |
| | | | WL1 | 4 | 2.001 | 0.9980 | 504 | 7 200 | 77 000 | 0.963 | 2 970 | 21 100 | 0.258 | Yes | 0 |
| | | | 2 | | 2.000 | 0.9985 | 504 | 7 500 | 40 000 | 0.940 | 2 770 | 25 600 | 0.184 | Yes | 0 |
| | | | 3 | | 2.001 | 1.0[illegible] | 504 | 8 000 | 102 000 | 1.032 | 3 250 | 24 500 | 0.342 | Yes** | 2 |
| | 4x15 | 341040 | LW1 | 5 | 3.001 | 1.5000 | 1 507 | 11 300 | 53 000 | 1.573 | 5 900 | 26 300 | 0.370 | Yes** | 0 |
| | | | 2 | | 3.001 | 1.5006 | 1 507 | 11 300 | 55 000 | 1.570 | [illegible] | 26 400 | 0.377 | Yes** | 0 |
| | | | 3 | | 3.003 | 1.5027 | 1 507 | 11 500 | 59 000 | [illegible] | 5 050 | 27 100 | 0.338 | Yes** | 4 |
| | | | WL1 | 5 | 3.001 | 1.5010 | 1 693 | 10 400 | 143 000 | 1.662 | 3 650 | 16 000 | 0.204 | No*** | 0 |
| | | | 2 | | 3.001 | 1.5010 | 1 693 | 9 700 | 63 000 | [illegible] | 4 250 | 19 700 | 0.246 | No*** | 0 |
| | | | 3 | | 3.001 | 1.5006 | 1 683 | 9 800 | 33 000 | 1.662 | 4 240 | 19 380 | 0.250 | No*** | 0 |
| | | | TL1 | 1 | 0.501 | 0.2496 | 85 | 8 300 | 86 000 | 0.262 | 265 | 13 700 | 0.195 | Yes | 0 |
| | | | 2 | | 0.500 | 0.2497 | 85 | 7 400 | 63 000 | 0.263 | 280 | 17 100 | 0.182 | Yes | 0 |
| | | | 3 | | 0.500 | 0.2495 | 85 | 7 000 | 82 000 | 0.257 | 273 | 17 300 | 0.184 | Yes | 0 |
| | 5x27 | 341043 | LW1 | 5 | 3.002 | 1.5010 | 1 085 | 10 700 | 119 000 | 1.659 | 6 180 | 30 800 | 0.561 | No*** | 0 |
| | | | 2 | | 3.002 | 1.5020 | 1 083 | 9 700 | 148 000 | 1.532 | 5 200 | [illegible] | [illegible] | Yes*** | 0 |
| | | | 3 | | 3.003 | 1.5020 | 1 085 | 8 700 | 205 000 | 1.635 | 4 180 | 25 100 | 0.304 | Yes*** | 2 |
| | | | WL1 | 5 | 3.003 | 1.5000 | 1 693 | 9 500 | 67 000 | [illegible] | 5 060 | 22 400 | 0.377 | Yes** | 0 |
| | | | 2 | | 3.002 | 1.5010 | 1 083 | 9 000 | [illegible] | [illegible] | 6 020 | 25 600 | [illegible] | Yes** | 0 |
| | | | 3 | | 3.003 | 1.5010 | 1 063 | 10 700 | 41 000 | [illegible] | 4 310 | [illegible] | [illegible] | No*** | 0 |
| | | | TL1 | 2 | [illegible] | 0.5001 | 200 | 9 100 | 113 000 | 0.485 | 900 | 18 500 | 0.218 | Yes | 0 |
| | | | 2 | | 1.001 | [illegible] | 200 | 9 200 | 38 000 | 0.467 | 900 | 19 500 | [illegible] | Yes** | 0 |
| | | | 3 | | 1.003 | 0.5000 | 200 | 10 000 | 57 000 | 0.517 | [illegible] | 18 100 | [illegible] | Yes** | 0 |
| | 6x34 | 341045 | LW1 | 6 | 4.005 | 2.0010 | 2 500 | 12 100 | 118 000 | 1.983 | 11 750 | 38 500 | [illegible] | Yes | 10 |
| | | | 2 | | 4.005 | 2.0010 | 2 500 | 13 300 | 132 000 | 1.955 | 12 660 | 38 800 | [illegible] | Yes** | 10 |
| | | | 3 | | 4.005 | 2.0010 | 2 500 | 13 400 | 126 000 | [illegible] | 12 600 | 31 100 | [illegible] | Yes** | 10 |
| | | | WL1 | 6 | 4.002 | 2.0010 | 2 500 | 13 600 | 134 000 | [illegible] | 8 600 | 24 600 | [illegible] | Yes** | 0 |
| | | | 2 | | 4.007 | 2.0010 | 2 500 | 13 000 | 52 000 | [illegible] | 8 750 | 28 400 | [illegible] | Yes** | 0 |
| | | | 3 | | 4.005 | 2.0010 | 2 500 | 13 500 | 58 000 | [illegible] | 7 500 | 24 100 | 0.438 | Yes** | 0 |
| | | | TL1 | 2 | 1.001 | 0.5010 | 187 | 8 400 | 307 000 | 0.482 | 875 | 18 400 | 0.293 | Yes | 0 |
| | | | 2 | | 1.001 | 0.5023 | 187 | 8 500 | 251 000 | 0.470 | 845 | 17 600 | 0.230 | Yes | 0 |
| | | | 3 | | 1.001 | 0.5017 | 187 | 8 700 | 258 000 | 0.483 | 900 | 18 700 | 0.253 | Yes | 0 |

* The first letter indicates the direction of a line normal to the crack plane in the specimen; the second letter indicates the direction of crack growth. L = Longitudinal, [illegible], W = Width, T = Thickness.
† [illegible]
‡ [illegible]
§ [illegible]

** $K_Q$ = [illegible], notch-bend specimens

$K_Q = \frac{P\sqrt{a}}{BW}$ [illegible], compact tension specimens

where [illegible]

*** [illegible]
†† [illegible]
‡‡ [illegible]
§§ [illegible]

TABLE XXIII

SUMMARY OF MEANINGFUL $K_{Ic}$ VALUES FOR STRESS-RELIEVED ALUMINUM ALLOY HAND FORGINGS

(F33615-68-C-1335)

| Alloy and Temper | Sample Cross-Sect. Size, in. | Sample Number | Longitudinal (LW) Number of Meaningful Tests | Longitudinal (LW) Nominal Specimen Thickness, in. | Longitudinal (LW) $K_{Ic}$, psi$\sqrt{in.}$* | Long-Transverse (WL) Number of Meaningful Tests | Long-Transverse (WL) Nominal Specimen Thickness, in. | Long-Transverse (WL) $K_{Ic}$, psi$\sqrt{in.}$* | Short-Transverse (TL) Number of Meaningful Tests | Short-Transverse (TL) Nominal Specimen Thickness | Short-Transverse (TL) $K_{Ic}$, psi$\sqrt{in.}$* |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 2014-T652 | 2x8 | 341007 | 3 | 0.75 | 25 400 | 2 | 0.75 | 19 200 | --- | --- | --- |
| | 3x12 | 341008 | 3 | 1.00 | 26 600 | 2 | 1.00 | 19 900 | --- | --- | --- |
| | 4x16 | 341010 | 3 | 1.50 | 34 100 | 3 | 1.50 | 23 100 | 3 | 0.25 | 19 100 |
| | 5x20 | [illegible] | 3 | 1.50 | 29 200 | 3 | 1.50 | 19 600 | 3 | 0.50 | 18 100 |
| | 6x24 | [illegible] | --- | --- | --- | 3 | 2.00 | 26 000 | 3 | 0.50 | 24 300 |
| | Average | | | | 28 800 | | | 21 600 | | | 20 500 |
| 2014-T6510 | Extrusions† | | | | 30 100 | | | 25 400 | | | --- |
| 2024-T852 | 2x8 | 341017 | 3 | 0.75 | 24 200 | 3 | 0.75 | 21 500 | --- | --- | --- |
| | 3x12 | 341018 | 3 | 1.00 | 2[illegible] 000 | 3 | 1.00 | 17 700 | --- | --- | --- |
| | 4x15 | 341020 | 3 | 1.50 | 27 300 | --- | --- | --- | 3 | 0.25 | 15 600 |
| | 5x20 | [illegible] | 3 | 1.50 | 27 100 | 3 | 1.50 | 17 600 | 2 | 0.50 | 15 900 |
| | 6x24 | [illegible] | 3 | 2.00 | 29 900 | 2 | 2.00 | 16 600 | 3 | 0.50 | 16 200 |
| | Average | | | | 26 300 | | | 18 400 | | | 15 900 |
| 2024-T8510 | Extrusions† | | | | 29 000 | | | 18 200 | | | --- |
| 7075-T7352 | 2x8 | 341027 | 3 | 0.75 | 31 400 | 2 | 0.75 | 24 000 | --- | --- | --- |
| | 3x12 | 341025 | 3 | 1.00 | 31 400 | 3 | 1.00 | 23 200 | --- | --- | --- |
| | 4x16 | 341030 | 3 | 1.50 | 32 700 | 3 | 1.50 | 26 500 | 3 | 0.25 | 17 800 |
| | 5x20 | 341035 | 3 | 1.50 | 34 900 | 3 | 1.50 | 28 000 | 3 | 0.50 | 19 000 |
| | 6x24 | 341036 | 2 | 2.00 | 39 500 | 2 | 2.00 | 27 700 | 3 | 0.50 | 25 600 |
| | Average | | | | 34 000 | | | 25 900 | | | 20 500 |
| 7075-T73510 | Extrusions† | | | | 34 200 | | | 26 300 | | | --- |
| 7079-T652 | 2x8 | 341037 | 3 | 0.75 | 25 000 | 1 | 0.75 | 24 700 | --- | --- | --- |
| | 3x12 | 341038 | 2 | 1.00 | 27 400 | 3 | 1.00 | 23 200 | --- | --- | --- |
| | 4x16 | 341040 | 3 | 1.50 | 26 600 | 1 | 1.50 | 19 500 | 3 | 0.25 | 18 000 |
| | 5x20 | 341043 | 2 | 1.50 | 26 100 | 2 | 1.50 | 24 000 | 3 | 0.50 | 18 200 |
| | 6x24 | 341045 | 3 | 2.00 | 30 100 | 3 | 2.00 | 23 700 | 3 | 0.50 | 18 100 |
| | Average | | | | 27 600 | | | 23 000 | | | 18 100 |
| 7079-T6510 | Extrusions† | | | | 30 900 | | | 29 200 | | | --- |

* Meaningful values of $K_Q$ from Table XXII.

† Average values obtained in a previous investigation (Technical Report AFML-TR-68-[illegible]); included for comparison.

TABLE XXIV

RESULTS OF LONG-TRANSVERSE AXIAL-STRESS FATIGUE TESTS
OF STRESS-RELIEVED ALUMINUM ALLOY HAND FORGINGS (R=0.0)
(F33615-68-C-1385)

| Alloy and Temper | Sample Size, in. | Sample Number | Cycles to Failure | | |
|---|---|---|---|---|---|
| | | | Maximum Stress, psi | | |
| | | | 60 000 | 40 000 | 35 000 |
| 2014-T652 | 2x8 | 341007 | 34 200 | 4 358 100 | 10 264 500* |
| | 4x8 | 341009 | 17 700 | 1 032 800 | 6 252 200 |
| | 5x10 | 341012 | 18 900 | 230 000 | 10 017 300* |
| | 6x12 | 341015 | 7 700 | 142 200 | 14 323 200* |
| | Log-Mean Fatigue Life | | 17 200 | 619 400 | --- |
| 2024-T852 | 2x8 | 341017 | 22 600 | 252 900 | 10 029 500* |
| | 4x8 | 341019 | 12 700 | 180 700 | 19 845 700* |
| | 5x10 | 341022 | 14 300 | 90 200 | 17 189 300* |
| | 6x12 | 341015 | 7 200 | 93 600 | 14 882 400* |
| | Log-Mean Fatigue Life | | 13 700 | 140 200 | --- |
| | | | Maximum Stress, psi | | |
| | | | 60 000 | 45 000 | 38 000 |
| 7075-T7352 | 2x8 | 341027 | 28 100 | 4 084 800 | 14 882 600* |
| | 4x8 | 341029 | 4 700 | 82 400 | 1 455 800 |
| | 5x10 | 341032 | 9 800 | 51 100 | 105 800 |
| | 6x12 | 341035 | 3 600 | 38 600 | 93 000 |
| | Log-Mean Fatigue Life | | 8 300 | 160 500 | --- |
| 7079-T652 | 2x8 | 341037 | 22 200 | 109 800 | 720 500 |
| | 4x8 | 341039 | 22 700 | 61 400 | 11 607 400* |
| | 5x10 | 341042 | 19 200 | 75 500 | 162 700 |
| | 6x12 | 341045 | 11 400 | 40 200 | 146 400 |
| | Log-Mean Fatigue Life | | 18 100 | 66 900 | --- |

* Specimen did not fail.

Table XXV

SCOPE OF CORROSION TESTS OF STRESS-RELIEVED ALUMINUM ALLOY HAND FORGINGS

Part A : Stress-Corrosion Tests: Number of Specimens Per Stress-Level

| Stress Levels | 26 Weeks Exposure: Longitudinal* All Four Alloy-Tempers | 26 Weeks Exposure: Long Transverse* 2014-T652 7079-T652 | 26 Weeks Exposure: Long Transverse* 2024-T852 7075-T652 | 12 Weeks Exposure: Short Transverse+ 2014-T652 7079-T652 | 12 Weeks Exposure: Short Transverse+ 2024-T352 | 12 Weeks Exposure: Short Transverse+ 7075-T7352 |
|---|---|---|---|---|---|---|
| 75% Y.S. | 3 | 3 | 3 | --- | 3 | 3 |
| 50% Y.S. | --- | 3 | --- | --- | 3 | --- |
| 22.5 KSI | --- | --- | --- | 3 | --- | --- |
| 15.0 KSI | --- | --- | --- | 3 | --- | --- |
| 7.5 KSI | --- | --- | --- | 3 | --- | --- |
| Unstressed | 2 | 2 | 2 | 2 | 2 | 2 |

* Longitudinal and long-transverse tensile specimens, 0.437-in. diameter, from 2X8, 4X16 and 6X24-in. forgings.

\+ Short-transverse tensile specimens, 0.125-in. diameter, from 2X8, 3X12, 4X16, 5X20 and 6X24-in. forgings.

Part B : Exfoliation Tests : Number of Panels ++

| Forging Size, In. | 2014-T652 | 2024-T852 | 7075-T7352 | 7079-T652 |
|---|---|---|---|---|
| 2X8 | 2 | 2 | 2 | 2 |
| 6X24 | 2 | 2 | 2 | 2 |

++ Panels 4X6 in. with 6 in. dimension in longitudinal direction.

TABLE XXVI

RESULTS OF STRESS-CORROSION TESTS OF LONGITUDINAL AND LONG-TRANSVERSE SPECIMENS
TRIPLICATE 0.437-IN. DIAMETER TENSION SPECIMENS STRESSED IN DIRECT TENSION*

Exposure : 3.5% NaCl Solution by Alternate Immersion **

| Alloy & Temper | Forging Size, In. | Sample Number | Longitudinal Specimens Stressed 75% Y.S. F/N+ | Days | Long-Transverse Specimens Stressed 75% Y.S. F/N+ | Days | Long-Transverse Specimens Stressed 50% Y.S. F/N+ | Days |
|---|---|---|---|---|---|---|---|---|
| 2014-T652 | 2X8 | 341007 | 0/3 | OK - 182 | 3/3 | 8,59,64 | 0/3 | OK - 182 |
| | 4X16 | 341010 | 0/3 | OK - 182 | 2/3 | 59,60,182# | 0/3 | OK - 182 |
| | 6X24 | 341016 | 0/3 | OK - 182 | 2/3 | 23,113 (1-OK-182) | 0/3 | OK - 182 |
| 2024-T352 | 2X8 | 341017 | 0/3 | OK - 182 | 0/3 | OK - 182 | --- | -------- |
| | 4X16 | 341020 | 0/3 | OK - 182 | 0/3 | OK - 182 | --- | -------- |
| | 6X24 | 341026 | 0/3 | OK - 182 | 0/3 | OK - 182 | --- | -------- |
| 7075-T7352 | 2X8 | 341027 | 0/3 | OK - 182 | 0/3 | OK - 182 | --- | -------- |
| | 4X16 | 341030 | 0/3 | OK - 182 | 0/3 | OK - 182 | --- | -------- |
| | 6X24 | 341036 | 0/3 | OK - 182 | 0/3 | OK - 182 | --- | -------- |
| 7079-T652 | 2X8 | 341037 | 0/3 | OK - 182 | 3/3 | 27,59,64 | 0/3 | OK - 182 |
| | 4X16 | 341040 | 0/3 | OK - 182 | 3/3 | 20,26,182# | 0/3 | OK - 182 |
| | 6X24 | 341046 | 0/3 | OK - 182 | 0/3 | OK - 182 | 0/3 | OK - 182 |

* Duplicate unstressed specimens (longitudinal and long-transverse) were also exposed for each alloy. (Table XXVII)

\+ F/N denotes number of specimens failed over number exposed.

\# Specimen failed outside the reduced section, beneath the protective coating used to isolate all parts of the stressing frame.

** Specimens from the 2, 3 and 5-in. thick forgings were exposed during months of November through May; specimens from the 4 and 6-in. forgings exposed during April through October.

Table XXVII

PER CENT REDUCTION IN TENSILE STRENGTH BY CORROSION OF LONGITUDINAL AND LONG-TRANSVERSE SPECIMENS, 0.437-IN. DIAMETER*

Exposure : 3.5% NaCl Solution by Alternate Immersion - 182 Days**

| | | | Longitudinal Specimens | | Long-Transverse Specimens | | |
|---|---|---|---|---|---|---|---|
| Alloy & Temper | Forging Size, In. | Sample Number | Unstressed | Stressed 75% Y.S. | Unstressed | Stressed 75% Y.S. | Stressed 50% Y.S. |
| 2014-T652 | 2X8 | 341007 | 5 | 8 | 1 | + | 29 |
| | 4X16 | 341010 | 6 | 8 | 19 | + | 28 |
| | 6X24 | 341016 | 5 | 6 | 18 | 27# | 17 |
| 2024-T852 | 2X3 | 341017 | 1 | 0 | 7 | 7 | -- |
| | 4X16 | 341020 | 7 | 4 | 23 | 15 | -- |
| | 6X24 | 341026 | 6 | 4 | 19 | 15 | -- |
| 7075-T7352 | 2X3 | 341027 | 0 | 1 | 10 | 13 | -- |
| | 4X16 | 341030 | 7 | 8 | 8 | 11 | -- |
| | 6X24 | 341035 | 0 | 0 | 1 | 2 | -- |
| 7079-T652 | 2X3 | 341037 | 2 | 1 | 0 | + | 17 |
| | 4X16 | 341040 | 2 | 4 | 1 | + | 20 |
| | 6X24 | 341046 | 3 | 3 | 1 | 3 | 3 |

* Results are average values for tensile tests of duplicate unstressed and triplicate stressed specimens unless otherwise noted.

\+ No value obtained since all specimens failed in stress-corrosion test.

\# Value for tensile test of single specimen which did not fail in stress-corrosion test.

** Specimens from the 2, 3 and 5-in. thick forgings were exposed during months of November through May; specimens from the 4 and 6-in. forgings exposed during April through October.

Table XXVIII

RESULTS OF STRESS-CORROSION TESTS OF SHORT-TRANSVERSE SPECIMENS
TRIPLICATE 0.125-IN. DIAMETER TENSION SPECIMENS STRESSED IN DIRECT TENSION*

Exposure : 3.5% NaCl Solution by Alternate Immersion##

| Alloy & Temper | Forging Size, In. | Sample Number | Stressed 75% Y.S. F/N+ | Stressed 75% Y.S. Days | Stressed 50% Y.S. F/N+ | Stressed 50% Y.S. Days | Stressed 22.5 ksi F/N+ | Stressed 22.5 ksi Days | Stressed 15.0 ksi F/N+ | Stressed 15.0 ksi Days | Stressed 7.5 ksi F/N+ | Stressed 7.5 ksi Days |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2014-T652 | 2X8 | 341007** | --- | ---- | --- | ---- | 0/3 | OK - 84 | 0/3 | OK - 84 | 0/3 | OK - 84 |
| | 3X12 | 341008 | --- | ---- | --- | ---- | 3/3 | 6,8,8 | 1/3 | 84(2-OK-84) | 0/3 | OK - 84 |
| | 4X16 | 341010 | --- | ---- | --- | ---- | 3/3 | 4,4,4 | 1/3 | 6(2-OK-84) | 0/3 | OK - 84 |
| | 5X20 | 341013 | --- | ---- | --- | ---- | 0/3 | OK - 84 | 0/3 | OK - 84 | 0/3 | OK - 84 |
| | 6X24 | 341016 | --- | ---- | --- | ---- | 3/3 | 4,5,5 | 3/3 | 10,13,21 | 0/3 | OK - 84 |
| 2024-T852 | 2X8 | 341017 | 3/3 | 14,84,84# | 0/3 | OK - 84 | --- | ---- | --- | ---- | --- | ---- |
| | 3X12 | 341018 | 0/3 | OK - 84 | 0/3 | OK - 84 | --- | ---- | --- | ---- | --- | ---- |
| | 4X16 | 341020 | 3/3 | 3,3,4 | 2/3 | 19,61 (1-OK-84) | --- | ---- | --- | ---- | --- | ---- |
| | 5X20 | 341023 | 0/3 | OK - 84 | 0/3 | OK - 84 | --- | ---- | --- | ---- | --- | ---- |
| | 6X24 | 341026 | 3/3 | 24,29,33 | 0/3 | OK - 84 | --- | ---- | --- | ---- | --- | ---- |
| 7075-T7352 | 2X8 | 341027 | 0/3 | OK - 84 | --- | ---- | --- | ---- | --- | ---- | --- | ---- |
| | 3X12 | 341028** | 3/3 | 8,8,8 | --- | ---- | --- | ---- | --- | ---- | --- | ---- |
| | 4X16 | 341030 | 1/3 | 64++ (2-OK-84) | --- | ---- | --- | ---- | --- | ---- | --- | ---- |
| | 5X20 | 341033 | 0/3 | OK - 84 | --- | ---- | --- | ---- | --- | ---- | --- | ---- |
| | 6X24 | 341036 | 0/3 | OK - 84 | --- | ---- | --- | ---- | --- | ---- | --- | ---- |
| 7079-T652 | 2X8 | 341037** | --- | ---- | --- | ---- | 0/3 | OK - 84 | 0/3 | OK - 84 | 0/3 | OK - 84 |
| | 3X12 | 341038 | --- | ---- | --- | ---- | 0/3 | OK - 84 | 0/3 | OK - 84 | 0/3 | OK - 84 |
| | 4X16 | 341040 | --- | ---- | --- | ---- | 3/3 | 3,4,4 | 3/3 | 4,4,4 | 3/3 | 6,9,19 |
| | 5X20 | 341043 | --- | ---- | --- | ---- | 2/3 | 15,27 (1-OK-84) | 0/3 | OK - 84 | 0/3 | OK - 84 |
| | 6X24 | 341046 | --- | ---- | --- | ---- | 3/3 | 5,5,8 | 2/3 | 13,84(1-OK-84) | 0/3 | OK - 84 |

* Duplicate unstressed specimens were also exposed in each instance. (Table XXIX)
\+ F/N denotes number of specimens failed over number exposed.
\# Specimen failed outside the reduced section, beneath the protective coating used to isolate all parts of the stressing frame.
** Forgings were retested to confirm these test results (See Table XXX)
++ Failure not typical of stress-corrosion cracking.
\#\# Specimens from 2, 3, and 5-in. thick forgings were exposed during months of November through February; specimens from 4 and 6-in. forgings exposed during April through July.

Table XXIX

PER CENT REDUCTION IN TENSILE STRENGTH BY CORROSION OF SHORT-TRANSVERSE SPECIMENS, 0.125-IN. DIAMETER*

Exposure: 3.5% NaCl Solution by Alternate Immersion **

| Alloy & Temper | Forging Size, In. | Sample Number | Unstressed | Stressed 75% Y.S. | Stressed 50% Y.S. | Stressed 22.5 ksi | Stressed 15.0 ksi | Stressed 7.5 ksi |
|---|---|---|---|---|---|---|---|---|
| 2014-T652 | 2X8 | 341007 | 8 | --- | --- | 21 | 17 | 9 |
| | 3X12 | 341008 | 9 | --- | --- | + | 35# | 21 |
| | 4X16 | 341010 | 37 | --- | --- | + | 56# | 65 |
| | 5X20 | 341013 | 11 | --- | --- | 23 | 14 | 9 |
| | 6X24 | 341016 | 20 | --- | --- | + | + | 23 |
| 2024-T352 | 2X8 | 341017 | 13 | + | 17 | --- | --- | --- |
| | 3X12 | 341018 | 9 | 8 | 9 | --- | --- | --- |
| | 4X16 | 341020 | 49 | + | + | --- | --- | --- |
| | 5X20 | 341023 | 8 | 6 | 5 | --- | --- | --- |
| | 6X24 | 341025 | 40 | + | 30 | --- | --- | --- |
| 7075-T652 | 2X8 | 341027 | 3 | 7 | --- | --- | --- | --- |
| | 3X12 | 341028 | 6 | + | --- | --- | --- | --- |
| | 4X16 | 341030 | 16 | 53# | --- | --- | --- | --- |
| | 5X20 | 341033 | 8 | 11 | --- | --- | --- | --- |
| | 6X24 | 341036 | 8 | 26 | --- | --- | --- | --- |
| 7079-T652 | 2X8 | 341037 | 4 | --- | --- | 5 | 0 | 2 |
| | 3X12 | 341038 | 3 | --- | --- | 0 | 0 | 2 |
| | 4X16 | 341040 | 19 | --- | --- | + | + | + |
| | 5X20 | 341043 | 3 | --- | --- | 1# | 0 | 1 |
| | 6X24 | 341046 | 12 | --- | --- | + | 34# | 16 |

* Results are average values for tensile tests of duplicate unstressed and triplicate stressed specimens unless otherwise noted.
\+ No value obtained since all specimens failed in stress-corrosion test, or were damaged in handling.
\# Results are average values for tensile tests of specimens (1 or 2) that did not fail in stress-corrosion test.
** Specimens from 2, 3, and 5-in. thick forgings were exposed during months of November through February; specimens from 4 and 6-in. forgings exposed during April through July.

TABLE XXX

RESULTS OF SUPPLEMENTARY STRESS-CORROSION TESTS OF SHORT-TRANSVERSE SPECIMENS TRIPLICATE 0.125-IN. DIAMETER TENSION SPECIMENS STRESSED IN DIRECT TENSION*

Exposure: 3.5% NaCl Solution by Alternate Immersion

| Alloy & Temper | Forging Size, In. | Sample Number | Applied Stress, ksi | Initial Test Results++ P/M+ | Initial Test Results++ Days | Initial Test Results++ % Loss in T.S.*** | Supplementary Test Results## P/M+ | Supplementary Test Results## Days | Supplementary Test Results## % Loss in T.S.*** |
|---|---|---|---|---|---|---|---|---|---|
| 7075-T7352 | 3X12 | 341023 | 45 (75% Y.S.) | 3/3 | 8,8,8 | --- | 3/3 | 7, 15, 15 | --- |
| | | | 40# | --- | ----- | --- | 3/3 | 7, 15, 27 | --- |
| | | | 35 | --- | ----- | --- | 3/3 | 4, 28, 30 | --- |
| | | | 30 | --- | ----- | --- | 2/3 | 25, 25 (1-OK-84) | 44+++ |
| | | | 0 | --- | ----- | 9 | --- | ----- | 19** |
| 2014-T652 | 2X[illegible] | 341077 | 22.5 | 0/3 | OK - 84 | 21 | 3/3 | 4, 10, 10 | --- |
| | | | 15.0 | 0/3 | OK - 84 | 17 | 3/3 | 10, 28, 84 | --- |
| | | | 7.5 | 0/3 | OK - 84 | 9 | 0/3 | OK - 84 | 66 |
| | | | 0 | --- | ----- | 8 | --- | ----- | 35 |
| 7079-T652 | 2X[illegible] | 341057 | 22.5 | 0/3 | OK - 84 | 5 | 3/3 | 10, 10, 11 | --- |
| | | | 15.0 | 0/3 | OK - 84 | 0 | 0/3 | OK - 84 | 11 |
| | | | 7.5 | 0/3 | OK - 84 | 2 | 0/3 | OK - 84 | 11 |
| | | | 0 | --- | ----- | 4 | --- | ----- | 9 |

* Duplicate unstressed specimens were also exposed in each instance.

\+ P/M denotes number of specimens failed over number exposed.

\# Federal Specification for 7075-T73 products require satisfactory completion of 30 days exposure at 75% of minimum longitudinal yield strength. Application of criteria to 7075-T7352 forging would require completion of 30-day test at a stress of 39.7 ksi.

** Replicate groups of unstressed specimens showed 13 and 19 per cent reduction in strength after 4 and 8 weeks exposure, respectively.

++ Tests were initiated in November, 1968, and terminated in February, 1969.

\## Tests were initiated in July, 1969, and terminated in October, 1969.

*** Results are average values for tensile tests of duplicate unstressed and triplicate stressed specimens unless otherwise noted.

+++ Value for tensile test of single specimen which did not fail in stress corrosion test.

## TABLE XXXI

### SCHEDULE OF FATIGUE-CRACK-PROPAGATION TESTS HAND FORGINGS OF 6x24-IN. CROSS SECTION

| Specimen Orientation (Fig. 42) | Type of Notch* | Length of Specimen, in. | Environment** | Rate of Cycling, cpm | Maximum Gross Tensile Stresses to Propagate Cracks, ksi+ 2014-T652 | 2024-T652 | 7075-T7352 | 7079-T652 |
|---|---|---|---|---|---|---|---|---|
| LT (E) | Mild | 24 | Ambient | 310 | 8.2, 12.5 | | | |
| LT (E) | Sharp | 24 | Ambient | 310 | 8.2, 12.5 | | | |
| LT (E) | Sharp | 6 | Ambient | 310 | 8.2, 12.5 | | | |
| LT (E) | Sharp | 24 | Ambient | 310 | 8.2 to 12.5++ | | | |
| LT (E) | Sharp | 24 | Ambient | 310 | 12.5 to 8.2++ | | | |
| LT (E) | Elox | 24 | Ambient | 310 | | 8.2,12.5,17.5 | 8.2,12.5,17.5 | 8.2,12.5,17.5 |
| LT (F) | Elox | 24 | Ambient | 310 | | | 8.2 | 8.2 |
| L (E) | Elox | 24 | Ambient | 310 | | | 8.2 | 8.2 |
| L (F) | Elox | 24 | Ambient | 310 | | | 8.2,12.5 | 8.2,12.5 |
| L (FA) | Elox | 24 | Ambient | 310 | | | 8.2,12.5 | 8.2,12.5 |
| ST (L) | Elox | 6 | Ambient | 310 | | | 8.2,12.5 | 8.2,12.5 |
| ST (T) | Elox | 6 | Ambient | 310 | | | 8.2 | |
| LT (E) | Elox | 24 | Dry | 310 | | | 8.2 | 8.2 |
| LT (E) | Elox | 24 | Humid | 310 | | | 8.2 | 8.2 |
| LT (E) | Elox | 24 | Salt-Fog | 310 | | | 8.2 | 8.2 |
| LT (E) | Elox | 24 | Salt-Fog | 18 | | | 8.2 | 8.2 |

*See Figures 41, 43, 44 and 45 for specimen details.

**Ambient refers to uncontrolled, laboratory environment. Relative humidities were measured during progress of tests. Environments described as Dry, Humid and Salt-fog, were achieved within the specimen enclosure shown in Fig. 46. See text for details.

+Ratio of minimum to maximum gross stress, R, in test cycle = 1/3.

++Stress changed (increased or decreased) when crack length plus notch width totaled 1 in.

Most tests were made in duplicate; a few in triplicate.

APPENDIX

# TABLE XXXII

CRACK PROPAGATION FOR CENTER-NOTCHED FATIGUE SPECIMENS
6" x 26" 2014-T652 Hand Forgings
Long-Transverse Specimens, Geometrical Variables
Constant-Load Tests, Stress Ratio = 1/3

| Cycles | Fatigue Crack Length (in.) Avg. Left | Fatigue Crack Length (in.) Avg. Right | Total Notch Length (in.) | Per cent Cracked |
|---|---|---|---|---|
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |

**Notes:**

Cycles - Number of cycles of crack propagation.
Fatigue Crack Length - measured on specimen surface.
Total Notch Length - 0.50-in. long crack starter plus fatigue cracks.
Per cent Cracked - total notch length expressed as a per cent of gross width.
T = specimen thickness, in.

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# TABLE XXXIII

CRACK PROPAGATION FOR CENTER-NOTCHED FATIGUE SPECIMENS
[illegible] Hand Forging
Long-Transverse Specimens, Load Changes
Stress Ratio = 1/3

| CYCLES | FATIGUE CRACK LENGTH (IN.) LEFT | FATIGUE CRACK LENGTH (IN.) RIGHT | TOTAL NOTCH LENGTH (IN.) | PERCENT CRACKED |
|---|---|---|---|---|
| [illegible] — T = [illegible] IN. | | | | |
| 0. | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | 1.000 | [illegible] |
| [illegible] — T = [illegible] IN. | | | | |
| 0. | [illegible] | [illegible] | 1.000 | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | 1.250 | 1.250 | [illegible] | [illegible] |
| [illegible] — T = [illegible] IN. | | | | |
| 0. | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | 1.000 | [illegible] |
| [illegible] — T = [illegible] IN. | | | | |
| 0. | [illegible] | [illegible] | 1.000 | [illegible] |
| [illegible] | [illegible] | [illegible] | 1.000 | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | 1.250 | 1.250 | [illegible] | [illegible] |
| [illegible] — T = [illegible] IN. | | | | |
| 0. | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | 1.000 | [illegible] |
| [illegible] — T = [illegible] IN. | | | | |
| 0. | [illegible] | [illegible] | 1.000 | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | 1.250 | 1.250 | [illegible] | [illegible] |

| CYCLES | FATIGUE CRACK LENGTH (IN.) LEFT | FATIGUE CRACK LENGTH (IN.) RIGHT | TOTAL NOTCH LENGTH (IN.) | PERCENT CRACKED |
|---|---|---|---|---|
| [illegible] — T = [illegible] IN. | | | | |
| 0. | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | 1.000 | [illegible] |
| [illegible] — T = [illegible] IN. | | | | |
| 0. | [illegible] | [illegible] | 1.000 | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
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| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
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| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | 1.250 | 1.250 | [illegible] | 100.00 |
| [illegible] — T = [illegible] IN. | | | | |
| 0. | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | 1.000 | [illegible] |
| [illegible] — T = [illegible] IN. | | | | |
| 0. | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | 1.250 | 1.250 | [illegible] | [illegible] |
| [illegible] — T = [illegible] IN. | | | | |
| 0. | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | 1.000 | [illegible] |
| [illegible] — T = [illegible] IN. | | | | |
| 0. | [illegible] | [illegible] | 1.000 | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | 1.250 | 1.250 | [illegible] | [illegible] |

**Notes:**

Cycles - Number of cycles of crack propagation.
Fatigue Crack Length - measured on specimen surface.
Total Notch Length - 0.50-in. long crack starter plus fatigue cracks.
Per cent Cracked - total notch length expressed as a per cent of gross width.
T - specimen thickness, in.

## TABLE XXXIV

### CRACK PROPAGATION FOR CENTER-CRACKED FATIGUE SPECIMENS

6" x 24" 2024-T852 Hand Forging
Long-Transverse Specimens
Constant Load Tests, Stress Ratio = 1/3

341026 LTE

| CYCLES | FATIGUE CRACK LENGTH (IN.) AVG. LEFT | FATIGUE CRACK LENGTH (IN.) AVG. RIGHT | TOTAL NOTCH LENGTH (IN.) | PERCENT CRACKED |
|---|---|---|---|---|
| | | | T = .7496 IN. | |
| 341026LTE12024I852 | | | SIP = 8.2 KSI | |
| 0. | .155 | .145 | .500 | 16.65 |
| 22700. | .175 | .170 | .545 | 18.15 |
| 55300. | .210 | .210 | .620 | 20.65 |
| 78400. | .245 | .245 | .690 | 22.98 |
| 99200. | .280 | .278 | .758 | 25.24 |
| 116200. | .305 | .315 | .820 | 27.31 |
| 129800. | .340 | .345 | .885 | 29.47 |
| 144600. | .370 | .380 | .950 | 31.64 |
| 158100. | .410 | .420 | 1.030 | 34.30 |
| 178800. | .475 | .485 | 1.160 | 38.63 |
| 187400. | .510 | .515 | 1.225 | 40.79 |
| 194300. | .555 | .550 | 1.305 | 43.46 |
| 208800. | .615 | .615 | 1.430 | 47.62 |
| 213300. | .660 | .650 | 1.510 | 50.28 |
| 217400. | .695 | .680 | 1.575 | 52.45 |
| 223100. | .730 | .710 | 1.640 | 54.61 |
| 227000. | .765 | .750 | 1.715 | 57.11 |
| 231300. | .825 | .800 | 1.825 | 60.77 |
| 235400. | .890 | .840 | 1.930 | 64.27 |
| 236800. | .985 | .865 | 2.050 | 68.27 |
| 236800. | 1.400 | 1.400 | 3.000 | 99.90 |
| | | | T = .7501 IN. | |
| 341026LTE32024I852 | | | SIP = 8.2 KSI | |
| 0. | .145 | .155 | .500 | 16.66 |
| 39300. | .180 | .190 | .570 | 18.99 |
| 62500. | .205 | .215 | .620 | 20.65 |
| 81400. | .240 | .255 | .695 | 23.15 |
| 101200. | .275 | .280 | .755 | 25.15 |
| 119900. | .305 | .310 | .815 | 27.15 |
| 137000. | .340 | .350 | .890 | 29.65 |
| 152000. | .385 | .390 | .975 | 32.48 |
| 165400. | .425 | .430 | 1.055 | 35.14 |
| 176500. | .465 | .475 | 1.140 | 37.97 |
| 187000. | .505 | .515 | 1.220 | 40.64 |
| 196300. | .545 | .555 | 1.300 | 43.30 |
| 204600. | .600 | .610 | 1.410 | 46.97 |
| 211200. | .630 | .645 | 1.475 | 49.13 |
| 219500. | .675 | .700 | 1.575 | 52.47 |
| 227500. | .740 | .760 | 1.700 | 56.63 |
| 232000. | .795 | .820 | 1.815 | 60.46 |
| 235500. | .865 | .875 | 1.940 | 64.62 |
| 237000. | .895 | .910 | 2.005 | 66.79 |
| 237000. | 1.400 | 1.400 | 3.000 | 99.93 |

| CYCLES | FATIGUE CRACK LENGTH (IN.) AVG. LEFT | FATIGUE CRACK LENGTH (IN.) AVG. RIGHT | TOTAL NOTCH LENGTH (IN.) | PERCENT CRACKED |
|---|---|---|---|---|
| | | | T = .7491 IN. | |
| 341026LTE2_2024T852 | | | SIP = 12.5 KSI | |
| 0. | .150 | .150 | .500 | 16.67 |
| 16300. | .195 | .195 | .590 | 19.67 |
| 27800. | .250 | .240 | .690 | 23.00 |
| 36800. | .290 | .280 | .770 | 25.67 |
| 43100. | .345 | .335 | .880 | 29.33 |
| 48400. | .375 | .375 | .950 | 31.67 |
| 53600. | .420 | .420 | 1.040 | 34.67 |
| 57600. | .470 | .475 | 1.145 | 38.17 |
| 60600. | .495 | .500 | 1.195 | 39.83 |
| 63600. | .535 | .540 | 1.275 | 42.50 |
| 67800. | .595 | .595 | 1.390 | 46.33 |
| 70600. | .650 | .665 | 1.515 | 50.50 |
| 73300. | .725 | .735 | 1.660 | 55.33 |
| 73300. | 1.400 | 1.400 | 3.000 | 100.00 |
| | | | T = .7456 IN. | |
| 341026LTE62024I852 | | | SIP = 12.4 KSI | |
| 0. | .150 | .150 | .500 | 16.67 |
| 15300. | .200 | .195 | .595 | 19.83 |
| 29500. | .255 | .250 | .705 | 23.50 |
| 40300. | .320 | .315 | .835 | 27.81 |
| 45800. | .365 | .365 | .930 | 31.00 |
| 51500. | .415 | .410 | 1.025 | 34.17 |
| 54400. | .455 | .460 | 1.115 | 37.17 |
| 62200. | .505 | .525 | 1.230 | 41.00 |
| 66900. | .565 | .590 | 1.355 | 45.17 |
| 70200. | .660 | .660 | 1.500 | 50.00 |
| 71100. | .690 | .700 | 1.590 | 53.00 |
| 71100. | 1.400 | 1.400 | 3.000 | 100.00 |
| | | | T = .7504 IN. | |
| 341026LTE42024I852 | | | SIP = 12.5 KSI | |
| 0. | .150 | .150 | .500 | 16.66 |
| 2000. | .190 | .185 | .575 | 19.15 |
| 5800. | .225 | .215 | .640 | 21.31 |
| 7000. | .255 | .255 | .710 | 23.64 |
| 10500. | .315 | .320 | .835 | 27.81 |
| 11300. | .385 | .400 | .985 | 32.80 |
| 11300. | 1.400 | 1.400 | 3.000 | 99.90 |
| | | | T = .7509 IN. | |
| 341026LTE52024I852 | | | SIP = 12.4 KSI | |
| 0. | .150 | .160 | .500 | 16.66 |
| 1000. | .195 | .185 | .580 | 19.31 |
| 3000. | .245 | .245 | .690 | 22.97 |
| 5300. | .285 * | .295 | .780 | 25.97 |
| 5300. | 1.400 | 1.400 | 3.000 | 99.87 |

Notes:

Cycles - Number of cycles of crack propagation.
Fatigue Crack Length - measured on specimen surface.
Total Notch Length - 0.20-in. long crack starter plus fatigue cracks.
Per cent Cracked - total notch length expressed as a per cent of gross width.
T - specimen thickness, in.

# TABLE XXXV

**CRACK PROPAGATION FOR CENTER-CRACKED FATIGUE SPECIMENS**

6 x 24" 7075-T7352 Hand Forging
Longitudinal and Grain-Runout Specimens
Constant-Load Tests, Stress Ratio = 1/3

**361036 LF**

361036LF1 2025T7352 . . . . . SIG = 8.2 KSI — T = .7464 IN.

| CYCLES | FATIGUE CRACK LENGTH (IN.) AVG. LEFT | AVG. RIGHT | TOTAL NOTCH LENGTH (IN.) | PERCENT CRACKED |
|---|---|---|---|---|
| 0. | .160 | .160 | .560 | 16.66 |
| 22100. | .160 | .170 | .560 | 17.99 |
| 32600. | .180 | .195 | .575 | 19.15 |
| 44700. | .195 | .215 | .610 | 20.32 |
| 62900. | .220 | .245 | .665 | 22.15 |
| 74600. | .245 | .275 | .720 | 23.98 |
| 88000. | .265 | .300 | .765 | 25.48 |
| 103600. | .310 | .355 | .865 | 28.81 |
| 112700. | .335 | .385 | .920 | 30.65 |
| 119800. | .370 | .415 | .985 | 32.81 |
| 128600. | .410 | .470 | 1.080 | 35.98 |
| 136100. | .465 | .500 | 1.140 | 37.97 |
| 138600. | .470 | .540 | 1.210 | 40.31 |
| 142500. | .505 | .575 | 1.280 | 42.64 |
| 146300. | .535 | .610 | 1.345 | 44.80 |
| 150100. | .565 | .665 | 1.430 | 47.63 |
| 153900. | .605 | .715 | 1.520 | 50.63 |
| 156800. | .660 | .750 | 1.590 | 52.96 |
| 160700. | .715 | .820 | 1.735 | 57.79 |
| 162100. | .765 | .860 | 1.800 | 59.96 |
| 164700. | .775 | .935 | 1.910 | 63.62 |
| 167600. | .860 | 1.005 | 2.065 | 68.12 |
| 167900. | .870 | 1.035 | 2.105 | 70.12 |
| 169400. | .930 | 1.110 | 2.240 | 74.62 |
| 170500. | .980 | 1.195 | 2.375 | 79.11 |
| 170900. | 1.000 | 1.245 | 2.445 | 81.45 |
| 171200. | 1.010 | 1.280 | 2.490 | 82.94 |
| 171200. | 1.401 | 1.400 | 3.000 | 99.93 |

361036LF2 2025T7352 . . . . . SIG = 8.2 KSI — T = .7488 IN.

| CYCLES | FATIGUE CRACK LENGTH (IN.) AVG. LEFT | AVG. RIGHT | TOTAL NOTCH LENGTH (IN.) | PERCENT CRACKED |
|---|---|---|---|---|
| 0. | .150 | .150 | .500 | 16.66 |
| 17400. | .165 | .170 | .535 | 17.82 |
| 38200. | .200 | .200 | .600 | 19.99 |
| 57200. | .240 | .240 | .680 | 22.65 |
| 73800. | .285 | .285 | .765 | 25.48 |
| 86200. | .325 | .335 | .860 | 28.65 |
| 94000. | .375 | .380 | .955 | 31.81 |
| 101700. | .415 | .420 | 1.035 | 34.48 |
| 110300. | .460 | .470 | 1.130 | 37.64 |
| 117400. | .525 | .530 | 1.255 | 41.81 |
| 123400. | .580 | .585 | 1.365 | 45.47 |
| 129200. | .665 | .655 | 1.520 | 49.97 |
| 133400. | .710 | .720 | 1.630 | 54.30 |
| 136400. | .765 | .775 | 1.740 | 57.96 |
| 138100. | .820 | .825 | 1.845 | 61.46 |
| 139600. | .880 | .880 | 1.960 | 65.29 |
| 140800. | .930 | .955 | 2.085 | 69.45 |
| 142200. | 1.005 | 1.015 | 2.220 | 73.95 |
| 143300. | 1.075 | 1.080 | 2.355 | 78.45 |
| 144200. | 1.135 | 1.150 | 2.485 | 82.78 |
| 144600. | 1.190 | 1.215 | 2.610 | 86.94 |
| 144600. | 1.400 | 1.400 | 3.000 | 99.93 |

**361036 LF**

361036LF1 2025T7352 . . . . . SIG = 8.2 KSI — T = .7497 IN.

| CYCLES | FATIGUE CRACK LENGTH (IN.) AVG. LEFT | AVG. RIGHT | TOTAL NOTCH LENGTH (IN.) | PERCENT CRACKED |
|---|---|---|---|---|
| 0. | .155 | .165 | .500 | 16.65 |
| 32100. | .185 | .185 | .570 | 18.99 |
| 53000. | .225 | .215 | .640 | 21.32 |
| 68700. | .260 | .260 | .720 | 23.98 |
| 83000. | .290 | .290 | .780 | 25.98 |
| 94000. | .330 | .330 | .860 | 28.64 |
| 103200. | .375 | .375 | .950 | 31.64 |
| 110200. | .415 | .415 | 1.030 | 34.31 |
| 116800. | .465 | .465 | 1.130 | 37.64 |
| 123100. | .495 | .495 | 1.190 | 39.64 |
| 127900. | .535 | .540 | 1.275 | 42.46 |
| 133900. | .575 | .585 | 1.360 | 45.30 |
| 137100. | .635 | .645 | 1.480 | 49.30 |
| 141000. | .690 | .710 | 1.600 | 53.29 |
| 144100. | .750 | .775 | 1.725 | 57.46 |
| 146000. | .805 | .825 | 1.830 | 60.96 |
| 148800. | .850 | .895 | 1.945 | 64.79 |
| 152500. | .915 | .940 | 2.055 | 68.45 |
| 153900. | .965 | .995 | 2.160 | 71.95 |
| 155200. | 1.020 | 1.070 | 2.290 | 76.28 |
| 156100. | 1.080 | 1.155 | 2.435 | 81.11 |
| 156300. | 1.135 | 1.270 | 2.605 | 86.77 |
| 156900. | 1.400 | 1.400 | 3.000 | 99.93 |

361036LF3 2025T7352 . . . . . SIG = 8.2 KSI — T = .7494 IN.

| CYCLES | FATIGUE CRACK LENGTH (IN.) AVG. LEFT | AVG. RIGHT | TOTAL NOTCH LENGTH (IN.) | PERCENT CRACKED |
|---|---|---|---|---|
| 0. | .160 | .160 | .520 | 16.65 |
| 39000. | .225 | .195 | .620 | 18.65 |
| 57400. | .225 | .215 | .640 | 21.15 |
| 75100. | .270 | .245 | .715 | 23.81 |
| 90600. | .315 | .290 | .805 | 26.64 |
| 104200. | .355 | .330 | .885 | 29.38 |
| 114200. | .390 | .365 | .955 | 31.64 |
| 125100. | .445 | .430 | 1.075 | 35.82 |
| 134600. | .520 | .510 | 1.230 | 40.98 |
| 140400. | .570 | .560 | 1.330 | 44.64 |
| 146700. | .620 | .615 | 1.435 | 47.79 |
| 151800. | .680 | .680 | 1.560 | 51.98 |
| 155200. | .745 | .745 | 1.690 | 56.29 |
| 160400. | .815 | .815 | 1.830 | 60.96 |
| 163300. | .875 | .875 | 1.950 | 64.96 |
| 165500. | .920 | .920 | 2.040 | 68.10 |
| 166500. | .975 | .985 | 2.160 | 71.93 |
| 167400. | 1.065 | 1.050 | 2.315 | 76.43 |
| 168600. | 1.135 | 1.110 | 2.445 | 80.62 |
| 169500. | 1.215 | 1.255 | 2.670 | 88.91 |
| 169900. | 1.400 | 1.400 | 3.000 | 99.93 |

361036LT2 2025T7352 . . . . . SIG = 12.5 KSI — T = .7520 IN.

| CYCLES | FATIGUE CRACK LENGTH (IN.) AVG. LEFT | AVG. RIGHT | TOTAL NOTCH LENGTH (IN.) | PERCENT CRACKED |
|---|---|---|---|---|
| 0. | .155 | .165 | .500 | 16.66 |
| 7000. | .195 | .195 | .593 | 19.67 |
| 17900. | .245 | .240 | .685 | 22.83 |
| 17770. | .315 | .300 | .808 | 26.84 |
| 21700. | .355 | .345 | .888 | 29.79 |
| 24500. | .415 | .447 | 1.015 | 33.79 |
| 26600. | .465 | .450 | 1.115 | 37.17 |
| 28600. | .475 | .515 | 1.235 | 41.11 |
| 30100. | .515 | .550 | 1.315 | 43.77 |
| 31600. | .615 | .575 | 1.410 | 46.96 |
| 32600. | .670 | .645 | 1.515 | 50.61 |
| 33600. | .720 | .700 | 1.633 | 54.39 |
| 34700. | .770 | .760 | 1.710 | 56.97 |
| 35300. | .815 | .805 | 1.839 | 61.07 |
| 35800. | .855 | .855 | 1.940 | 64.91 |
| 37200. | .900 | .915 | 2.115 | 70.41 |
| 37700. | 1.135 | 1.015 | 2.365 | 78.79 |
| 37760. | 1.400 | 1.400 | 3.000 | 99.93 |

361036LT4 2025T7352 . . . . . SIG = 12.5 KSI — T = .7494 IN.

| CYCLES | FATIGUE CRACK LENGTH (IN.) AVG. LEFT | AVG. RIGHT | TOTAL NOTCH LENGTH (IN.) | PERCENT CRACKED |
|---|---|---|---|---|
| 0. | .155 | .165 | .500 | 16.67 |
| 4400. | .195 | .195 | .520 | 17.33 |
| 11000. | .215 | .230 | .645 | 22.17 |
| 15600. | .245 | .250 | .695 | 23.99 |
| 19000. | .305 | .325 | .810 | 26.97 |
| 23000. | .340 | .340 | .880 | 29.33 |
| 25000. | .445 | .445 | 1.055 | 35.15 |
| 28500. | .465 | .465 | 1.160 | 38.64 |
| 30000. | .535 | .545 | 1.260 | 42.13 |
| 32200. | .625 | .615 | 1.400 | 46.64 |
| 33100. | .665 | .655 | 1.520 | 50.64 |
| 34000. | .725 | .714 | 1.610 | 54.71 |
| 34500. | .845 | .865 | 1.910 | 63.63 |
| 35000. | .915 | .995 | 2.010 | 67.00 |
| 37200. | .965 | .965 | 2.155 | 71.81 |
| 37600. | 1.155 | 1.035 | 2.390 | 79.63 |
| 37600. | 1.400 | 1.400 | 3.000 | 100.00 |

**361036 LTA**

361036LTA2 2025T7352 . . . . . SIG = 8.2 KSI — T = .7507 IN.

| CYCLES | FATIGUE CRACK LENGTH (IN.) AVG. LEFT | AVG. RIGHT | TOTAL NOTCH LENGTH (IN.) | PERCENT CRACKED |
|---|---|---|---|---|
| 0. | .155 | .165 | .500 | 16.65 |
| 27000. | .190 | .185 | .575 | 19.15 |
| 70700. | .235 | .230 | .665 | 22.16 |
| 107600. | .265 | .265 | .730 | 24.32 |
| 120600. | .325 | .325 | .850 | 28.31 |
| 140600. | .365 | .365 | .930 | 31.07 |
| 150100. | .425 | .435 | 1.060 | 35.37 |
| 158700. | .475 | .480 | 1.155 | 38.46 |
| 164200. | .520 | .525 | 1.245 | 41.48 |
| 170100. | .555 | .565 | 1.320 | 43.96 |
| 174100. | .605 | .615 | 1.420 | 47.29 |
| 181500. | .675 | .700 | 1.575 | 52.46 |
| 184600. | .735 | .765 | 1.600 | 56.11 |
| 188900. | .795 | .825 | 1.820 | 60.61 |
| 190500. | .857 | .870 | 1.920 | 63.96 |
| 192600. | .917 | .935 | 2.065 | 68.79 |
| 194100. | .967 | .995 | 2.165 | 71.63 |
| 195800. | 1.029 | 1.070 | 2.300 | 76.60 |
| 196900. | 1.105 | 1.155 | 2.460 | 81.95 |
| 197400. | 1.135 | 1.235 | 2.570 | 85.58 |
| 197600. | 1.170 | 1.209 | 2.449 | [illegible] |
| 197805. | 1.460 | 1.403 | 3.000 | 99.93 |

361036LTA3 2025T7352 . . . . . SIG = 8.2 KSI — T = .7570 IN.

| CYCLES | FATIGUE CRACK LENGTH (IN.) AVG. LEFT | AVG. RIGHT | TOTAL NOTCH LENGTH (IN.) | PERCENT CRACKED |
|---|---|---|---|---|
| 0. | .155 | .165 | .500 | 16.67 |
| 44700. | .200 | .195 | .595 | 19.83 |
| 87600. | .265 | .265 | .600 | 23.32 |
| 116700. | .290 | .285 | .775 | 25.83 |
| 129600. | .325 | .330 | .855 | 28.50 |
| 142900. | .365 | .370 | .935 | 31.17 |
| 152200. | .417 | .415 | 1.030 | 34.37 |
| 157000. | .475 | .480 | 1.155 | 38.50 |
| 170500. | .525 | .530 | 1.255 | 41.83 |
| 181500. | .570 | .570 | 1.340 | 44.65 |
| 186900. | .605 | .605 | 1.409 | 46.97 |
| 190300. | .765 | .745 | 1.680 | 56.00 |
| 193200. | .809 | .790 | 1.704 | 56.89 |
| 196300. | .859 | .860 | 1.800 | 61.77 |
| 197100. | .905 | .909 | 1.906 | 66.17 |
| 199500. | .945 | .962 | 2.105 | 70.17 |
| 201500. | 1.015 | 1.099 | 2.210 | 73.81 |
| 201700. | 1.075 | 1.160 | 2.175 | 77.83 |
| 203100. | 1.170 | 1.150 | 2.420 | 80.70 |
| 204350. | 1.255 | 1.210 | 2.445 | 88.01 |
| 204360. | 1.499 | 1.400 | 3.000 | 100.00 |

361036LTA1 2025T7352 . . . . . SIG = 12.5 KSI — T = .7540 IN.

| CYCLES | FATIGUE CRACK LENGTH (IN.) AVG. LEFT | AVG. RIGHT | TOTAL NOTCH LENGTH (IN.) | PERCENT CRACKED |
|---|---|---|---|---|
| 0. | .155 | .150 | .500 | 16.66 |
| 5500. | .180 | .175 | .555 | 18.49 |
| 13100. | .230 | .215 | .645 | 21.49 |
| 17500. | .265 | .265 | .730 | 24.32 |
| 22250. | .305 | .305 | .810 | 26.99 |
| 26600. | .365 | .365 | .930 | 30.98 |
| 29000. | .390 | .400 | .990 | 32.98 |
| 30600. | .430 | .430 | 1.060 | 35.32 |
| 33000. | .465 | .470 | 1.135 | 37.81 |
| 36000. | .525 | .515 | 1.240 | 41.31 |
| 38000. | .575 | .585 | 1.360 | 45.30 |
| 39300. | .620 | .615 | 1.435 | 47.81 |
| 39500. | .665 | .665 | 1.530 | 50.98 |
| 40100. | .730 | .725 | 1.655 | 55.15 |
| 41500. | .780 | .760 | 1.740 | 57.99 |
| 42600. | .885 | .875 | 1.960 | 65.31 |
| 43600. | .925 | .935 | 2.060 | 68.64 |
| 44100. | .995 | 1.005 | 2.200 | 73.30 |
| 44300. | 1.075 | 1.075 | 2.350 | 78.31 |
| 44400. | 1.110 | 1.175 | 2.485 | 82.82 |
| 44400. | 1.400 | 1.400 | 3.000 | 99.93 |

361036LTA2 2025T7352 . . . . . SIG = 12.5 KSI — T = .7480 IN.

| CYCLES | FATIGUE CRACK LENGTH (IN.) AVG. LEFT | AVG. RIGHT | TOTAL NOTCH LENGTH (IN.) | PERCENT CRACKED |
|---|---|---|---|---|
| 0. | .150 | .150 | .500 | 16.67 |
| 11900. | .190 | .180 | .570 | 18.97 |
| 19100. | .225 | .215 | .640 | 21.33 |
| 40400. | .245 | .265 | .710 | 23.66 |
| 30600. | .300 | .305 | .805 | 26.83 |
| 33100. | .340 | .345 | .885 | 29.50 |
| 34300. | .395 | .395 | .990 | 33.00 |
| 37500. | .445 | .445 | 1.090 | 36.33 |
| 38900. | .490 | .495 | 1.185 | 39.50 |
| 40100. | .555 | .530 | 1.285 | 42.83 |
| 41000. | .620 | .570 | 1.390 | 46.33 |
| 41300. | .655 | .625 | 1.480 | 49.33 |
| 44400. | .700 | .670 | 1.570 | 52.33 |
| 45300. | .750 | .720 | 1.670 | 55.67 |
| 46700. | .805 | .760 | 1.765 | 58.83 |
| 47100. | .860 | .815 | 1.875 | 62.50 |
| 47900. | .925 | .860 | 1.985 | 66.17 |
| 48800. | .975 | .925 | 2.100 | 70.00 |
| 49000. | 1.030 | .965 | 2.195 | 73.17 |
| 49200. | 1.150 | 1.025 | 2.375 | 79.17 |
| 49300. | 1.400 | 1.409 | 3.009 | 100.00 |

**Notes:**

Cycles - Number of cycles of crack propagation.
Fatigue Crack Length - measured on specimen surface.
Total Notch Length - 0.20-in. long crack starter plus fatigue crack.
Per cent Cracked - total notch length expressed as a per cent of gross width.
T = specimen thickness, in.

# TABLE XXXVI

CRACK PROPAGATION FOR CENTER-CRACKED FATIGUE SPECIMENS
6" x 28" 7075-T7352 Hand Forgings
Short-Transverse and Long-Transverse Specimens
Constant-Load Tests, Stress Ratio = 1/[illegible]

| Cycles | Fatigue Crack Length (in.) Avg. Left | Fatigue Crack Length (in.) Avg. Right | Total Notch Length (in.) | Percent Cracked |
|---|---|---|---|---|
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |

**Notes:**

Cycles - Number of cycles of crack propagation.
Fatigue Crack Length - measured on specimen surface.
Total Notch Length - 0.20-in. long crack starter plus fatigue cracks.
Per cent Cracked - total notch length expressed as a per cent of gross width.
T = specimen thickness, in.

# TABLE XXXVII

CRACK PROPAGATION FOR CENTER-NOTCHED FATIGUE SPECIMENS
6" x 26" 7075-T7352 Hand Forgings
Long-Transverse Specimens, Controlled Environment
Constant-Load Tests, Stress Ratio = 1/3

### 341036 LTE LOW HUMIDITY

| CYCLES | FATIGUE CRACK LENGTH (IN.) AVG. LEFT | AVG. RIGHT | TOTAL NOTCH LENGTH (IN.) | PERCENT CRACKED |
|---|---|---|---|---|
| 341036LTE2A7B7S7Z3S2 | | | T = .7422 IN. | 8.2 KSI |
| 0. | .155 | .145 | .550 | 18.05 |
| 17100. | .190 | .195 | .575 | 19.15 |
| 56400. | .250 | .240 | .690 | 22.90 |
| 64000. | .310 | .270 | .780 | 25.97 |
| 77600. | .355 | .320 | .875 | 29.16 |
| 90200. | .405 | .375 | .975 | 32.47 |
| 101200. | .460 | .425 | 1.085 | 36.13 |
| 112000. | .515 | .480 | 1.195 | 40.13 |
| 117900. | .580 | .520 | 1.300 | 43.29 |
| 126700. | .635 | .575 | 1.410 | 46.95 |
| 129200. | .675 | .630 | 1.505 | 50.12 |
| 136700. | .735 | .685 | 1.620 | 53.95 |
| 139700. | .765 | .750 | 1.735 | 57.78 |
| 144000. | .840 | .805 | 1.845 | 61.44 |
| 147000. | .890 | .860 | 1.950 | 64.94 |
| 150000. | .960 | .910 | 2.050 | 68.27 |
| 153400. | .995 | .960 | 2.155 | 71.76 |
| 155500. | 1.070 | 1.050 | 2.270 | 75.59 |
| 156200. | 1.125 | 1.075 | 2.350 | 78.26 |
| 156200. | 1.440 | 1.400 | 3.000 | 99.90 |
| 341036LTE1A7B7S7Z3S2 | | | T = .7511 IN. | 8.2 KSI |
| 0. | .155 | .145 | .500 | 16.65 |
| 39600. | .190 | .210 | .600 | 19.98 |
| 72400. | .255 | .249 | .709 | 23.31 |
| 98500. | .365 | .300 | .800 | 26.64 |
| 114900. | .365 | .355 | .900 | 29.97 |
| 120600. | .395 | .405 | 1.100 | 33.[illegible] |
| 140000. | .455 | .445 | 1.100 | 36.63 |
| 148000. | .555 | .495 | 1.290 | 39.96 |
| 154400. | .555 | .545 | 1.300 | 43.29 |
| 165200. | .610 | .605 | 1.410 | 46.95 |
| 171200. | .670 | .670 | 1.540 | 51.28 |
| 174600. | .710 | .700 | 1.610 | 53.61 |
| 177000. | .750 | .745 | 1.695 | 56.44 |
| 182900. | .835 | .800 | 1.835 | 59.94 |
| 187000. | .955 | .950 | 1.975 | 63.64 |
| 193700. | .925 | .885 | 2.005 | 66.77 |
| 194000. | .965 | .965 | 2.110 | 70.26 |
| 197100. | 1.010 | .995 | 2.275 | 73.43 |
| 198400. | 1.095 | 1.065 | 2.390 | 78.76 |
| 198600. | 1.125 | 1.110 | 2.445 | 81.42 |
| 198800. | 1.440 | 1.400 | 3.000 | 99.90 |

### 341036 LTE SALT SPRAY

| CYCLES | FATIGUE CRACK LENGTH (IN.) AVG. LEFT | AVG. RIGHT | TOTAL NOTCH LENGTH (IN.) | PERCENT CRACKED |
|---|---|---|---|---|
| 341036LTE3A7B7S7Z3S2 | | | T = .7600 IN. | 8.2 KSI |
| 0. | .190 | .170 | .510 | 16.44 |
| 11700. | .210 | .165 | .575 | 17.48 |
| 21587. | .175 | .185 | .596 | 19.31 |
| 45137. | .255 | .264 | .695 | 23.16 |
| 57730. | .309 | .293 | .790 | 26.30 |
| 70230. | .360 | .335 | .915 | 30.46 |
| 75291. | .450 | .395 | .995 | 33.17 |
| 82030. | .635 | .475 | 1.370 | 35.47 |
| 87750. | .445 | .400 | 1.170 | 38.95 |
| 97250. | .520 | .570 | 1.259 | 41.61 |
| 98789. | .573 | .500 | 1.353 | 44.96 |
| 100502. | .615 | .630 | 1.445 | 48.13 |
| 105539. | .683 | .695 | 1.579 | 52.70 |
| 109060. | .735 | .750 | 1.709 | 56.90 |
| 112700. | .795 | .810 | 1.807 | 60.09 |
| 115600. | .879 | .875 | 1.944 | 64.50 |
| 118300. | .945 | .968 | 2.165 | 70.87 |
| 120190. | 1.020 | 1.030 | 2.250 | 74.90 |
| 121300. | 1.125 | 1.130 | 2.455 | 81.77 |
| 121300. | 1.440 | 1.400 | 3.000 | 99.87 |
| 341036LTE2A7B7S7Z3S2 | | | T = .7600 IN. | 8.2 KSI |
| 0. | .159 | .150 | .540 | 18.45 |
| 20179. | .185 | .165 | .575 | 18.98 |
| 36792. | .215 | .227 | .635 | 21.15 |
| 47600. | .255 | .265 | .720 | 23.98 |
| 56560. | .290 | .295 | .765 | 26.16 |
| 67500. | .340 | .365 | .805 | 29.47 |
| 77600. | .403 | .405 | 1.145 | 33.07 |
| 87100. | .440 | .400 | 1.150 | 38.43 |
| 92250. | .530 | .510 | 1.260 | 41.96 |
| 97100. | .609 | .509 | 1.365 | 45.45 |
| 100700. | .625 | .625 | 1.445 | 48.12 |
| 104700. | .640 | .675 | 1.530 | 51.95 |
| 107900. | .715 | .715 | 1.625 | 53.95 |
| 109620. | .765 | .750 | 1.690 | 56.20 |
| 111792. | .790 | .790 | 1.779 | 58.96 |
| 113000. | .922 | .835 | 1.885 | 62.18 |
| 115400. | .905 | .895 | 1.970 | 65.68 |
| 117000. | .945 | .950 | 2.100 | 69.93 |
| 119600. | 1.015 | 1.025 | 2.204 | 74.50 |
| 120200. | 1.195 | 1.175 | 2.420 | 80.58 |
| 120200. | 1.440 | 1.400 | 3.000 | 99.90 |

### 341036 LTE HIGH HUMIDITY

| CYCLES | FATIGUE CRACK LENGTH (IN.) AVG. LEFT | AVG. RIGHT | TOTAL NOTCH LENGTH (IN.) | PERCENT CRACKED |
|---|---|---|---|---|
| 341036LTE3A7B7S7Z3S2 | | | T = .7290 IN. | 8.2 KSI |
| 0. | .160 | .160 | .500 | 16.66 |
| 10000. | .175 | .195 | .543 | 18.81 |
| 34700. | .225 | .235 | .655 | 21.80 |
| 40697. | .255 | .270 | .725 | 24.13 |
| 61793. | .295 | .310 | .835 | 27.79 |
| 70177. | .330 | .352 | .869 | 29.20 |
| 79000. | .365 | .394 | .995 | 31.79 |
| 89700. | .409 | .420 | 1.075 | 34.72 |
| 91400. | .440 | .470 | 1.110 | 36.95 |
| 97000. | .472 | .505 | 1.195 | 39.45 |
| 101700. | .525 | .545 | 1.275 | 42.79 |
| 105700. | .551 | .509 | 1.335 | 44.44 |
| 109030. | .639 | .629 | 1.475 | 47.64 |
| 112600. | .610 | .640 | 1.483 | 49.48 |
| 114793. | .665 | .695 | 1.562 | 51.73 |
| 118700. | .799 | .747 | 1.643 | 54.79 |
| 121200. | .755 | .745 | 1.760 | 57.92 |
| 124024. | .753 | .849 | 1.830 | 60.77 |
| 126233. | .835 | .891 | 1.925 | 64.23 |
| 127700. | .880 | .939 | 2.015 | 67.01 |
| 129037. | .930 | .963 | 2.115 | 70.46 |
| 130700. | .963 | 1.049 | 2.223 | 73.94 |
| 131100. | 1.045 | 1.103 | 2.361 | 77.73 |
| 131400. | 1.098 | 1.139 | 2.435 | 81.44 |
| 131900. | 1.435 | 1.433 | 3.000 | 99.87 |
| 341036LTE1A7B7S7Z3S2 | | | T = .7058 IN. | 8.2 KSI |
| 0. | .165 | .175 | .580 | 16.47 |
| 23093. | .190 | .165 | .535 | 18.52 |
| 47000. | .215 | .223 | .577 | 21.23 |
| 56000. | .270 | .235 | .645 | 22.54 |
| 67901. | .315 | .303 | .709 | 24.51 |
| 76529. | .332 | .315 | .855 | 26.93 |
| 88173. | .365 | .393 | .915 | 31.33 |
| 94719. | .425 | .388 | 1.110 | 33.47 |
| 102700. | .440 | .525 | 1.195 | 36.19 |
| 108400. | .475 | .463 | 1.150 | 38.33 |
| 111900. | .525 | .490 | 1.215 | 41.54 |
| 114010. | .545 | .525 | 1.290 | 42.47 |
| 117100. | .605 | .569 | 1.363 | 45.54 |
| 121101. | .653 | .610 | 1.443 | 48.07 |
| 122779. | .705 | .660 | 1.500 | 50.78 |
| 126403. | .743 | .695 | 1.638 | 54.53 |
| 131900. | .795 | .763 | 1.720 | 57.33 |
| 134430. | .835 | .795 | 1.833 | 60.99 |
| 136299. | .875 | .820 | 1.895 | 63.17 |
| 136990. | .963 | .905 | 2.125 | 67.56 |
| 140190. | 1.063 | .975 | 2.235 | 70.97 |
| 140400. | 1.115 | 1.125 | 2.360 | 78.93 |
| 140900. | 1.440 | 1.400 | 3.000 | 100.00 |

### 341036 LTE SALT SPRAY, SLOW SPEED

| CYCLES | FATIGUE CRACK LENGTH (IN.) AVG. LEFT | AVG. RIGHT | TOTAL NOTCH LENGTH (IN.) | PERCENT CRACKED |
|---|---|---|---|---|
| 341036LTE4A7B7S7Z3S2 | | | T = .7509 IN. | 8.2 KSI |
| 0. | .155 | .165 | .507 | 16.09 |
| 29700. | .205 | .190 | .623 | 19.96 |
| 41700. | .260 | .270 | .795 | 22.90 |
| 60159. | .310 | .319 | .825 | 27.47 |
| 70230. | .350 | .305 | .915 | 30.47 |
| 87303. | .420 | .417 | 1.015 | 33.80 |
| 94107. | .445 | .475 | 1.135 | 37.90 |
| 107030. | .517 | .520 | 1.260 | 41.79 |
| 113797. | .509 | .504 | 1.399 | 45.62 |
| 119409. | .665 | .655 | 1.479 | 48.99 |
| 123000. | .750 | .769 | 1.715 | 54.94 |
| 126730. | .825 | .840 | 1.809 | 60.10 |
| 127992. | .909 | .929 | 1.995 | 66.77 |
| 130193. | .973 | .960 | 2.199 | 71.93 |
| 131100. | 1.155 | 1.119 | 2.410 | 80.25 |
| 131100. | 1.440 | 1.440 | 3.000 | 99.90 |
| 341036LTE2A7B7S7Z3S2 | | | T = .7503 IN. | 8.2 KSI |
| 0. | .175 | .170 | .545 | 18.45 |
| 24883. | .165 | .195 | .603 | [illegible] |
| 39579. | .219 | .229 | .638 | 21.25 |
| [illegible] | .255 | .263 | .775 | 23.89 |
| [illegible] | .255 | .275 | .790 | 26.09 |
| 91230. | .265 | .290 | .775 | 25.81 |
| 95189. | .335 | .341 | .875 | 27.70 |
| 99277. | .349 | .370 | .929 | 29.03 |
| [illegible] | .375 | .389 | .855 | 32.35 |
| [illegible] | .395 | .414 | .900 | 32.99 |
| 131933. | .535 | .519 | 1.215 | 41.66 |
| [illegible] | .545 | .509 | 1.305 | 44.79 |
| [illegible] | .575 | .575 | 1.441 | 47.95 |
| [illegible] | .625 | .640 | 1.509 | 52.11 |
| [illegible] | .730 | .675 | 1.750 | 54.81 |
| [illegible] | .790 | .860 | 1.570 | 60.00 |
| [illegible] | .865 | .905 | 1.650 | 66.75 |
| [illegible] | .925 | 1.190 | 2.127 | 70.68 |
| [illegible] | .965 | 1.225 | 2.161 | 72.20 |
| 127600. | .975 | 1.090 | 2.275 | 75.90 |
| 127600. | 1.440 | 1.440 | [illegible] | 99.90 |

Notes:

Cycles = Number of cycles of crack propagation.
Fatigue Crack Length = measured on specimen surface.
Total Notch Length = 0.25 in. long crack starter plus fatigue cracks.
Per Cent Cracked = total notch length expressed as a per cent of gross width.
T = specimen thickness, in.

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## TABLE XXXVIII

**CRACK PROPAGATION FOR CENTER-CRACKED FATIGUE SPECIMENS**
**6" x 23" 7079-T652 Hand Forging**
**Longitudinal and Grain-Normal Specimens**
**Constant-Load Tests, Stress Ratio = 1/3**

361046 LF

| CYCLES | FATIGUE CRACK LENGTH (IN.) AVG. LEFT | FATIGUE CRACK LENGTH (IN.) AVG. RIGHT | TOTAL NOTCH LENGTH (IN.) | PERCENT CRACKED |
|---|---|---|---|---|
| 361046LF1 [illegible] | | | T = .7486 IN. [illegible] | |
| 0. | .195 | .165 | .560 | 18.66 |
| 73100. | .205 | .195 | .595 | 19.81 |
| 97500. | .230 | .265 | .600 | 22.66 |
| 100000. | .255 | .275 | .730 | 24.30 |
| 125000. | .295 | .315 | .810 | 26.90 |
| 130000. | .350 | .370 | .900 | 30.43 |
| 163400. | .380 | .415 | .995 | 33.17 |
| 160000. | .430 | .465 | 1.095 | 36.45 |
| 157100. | .490 | .525 | 1.215 | 40.46 |
| 162500. | .530 | .580 | 1.313 | 43.61 |
| 165000. | .575 | .620 | 1.395 | 46.46 |
| 168000. | .615 | .670 | 1.485 | 49.43 |
| 172100. | .660 | .710 | 1.560 | 51.60 |
| 173300. | .680 | .735 | 1.635 | 54.43 |
| 175000. | .715 | .800 | 1.715 | 57.00 |
| 177700. | .760 | .865 | 1.875 | 58.75 |
| 179100. | .790 | .985 | 1.895 | 61.00 |
| 180500. | .825 | .955 | 1.900 | 65.91 |
| 182100. | .870 | 1.015 | 2.085 | 68.41 |
| 182700. | .930 | 1.080 | 2.210 | 73.57 |
| 184000. | .965 | 1.125 | 2.290 | 76.23 |
| 185700. | .995 | 1.175 | 2.370 | 78.90 |
| 187100. | 1.045 | 1.295 | 2.500 | 83.22 |
| 187300. | 1.400 | 1.400 | 3.000 | 99.87 |
| 361046LF2 [illegible] | | | T = .7486 IN. [illegible] | |
| 0. | .195 | .165 | .560 | 18.66 |
| 49000. | .210 | .185 | .595 | 19.81 |
| 71100. | .235 | .225 | .610 | 22.31 |
| 81100. | .260 | .275 | .795 | 25.16 |
| 90900. | .315 | .310 | .825 | 27.47 |
| 111000. | .375 | .365 | .940 | 31.30 |
| 120400. | .460 | .495 | 1.115 | 37.13 |
| 134000. | .520 | .510 | 1.230 | 40.96 |
| 140000. | .575 | .565 | 1.340 | 44.62 |
| 143100. | .615 | .600 | 1.415 | 47.12 |
| 146000. | .670 | .645 | 1.515 | 50.45 |
| 151300. | .760 | .715 | 1.695 | 56.11 |
| 154000. | .795 | .775 | 1.775 | 59.06 |
| 157000. | .805 | .895 | 1.900 | 64.60 |
| 159000. | .900 | .970 | 2.000 | 66.76 |
| 161900. | 1.015 | .960 | 2.175 | 72.43 |
| 163400. | 1.095 | 1.010 | 2.305 | 76.76 |
| 164900. | 1.155 | 1.050 | 2.415 | 80.42 |
| 165700. | 1.210 | 1.080 | 2.490 | 82.92 |
| 166000. | 1.265 | 1.150 | 2.595 | 86.41 |
| 168000. | 1.400 | 1.400 | 3.000 | 99.90 |

361046 LFB

| CYCLES | FATIGUE CRACK LENGTH (IN.) AVG. LEFT | FATIGUE CRACK LENGTH (IN.) AVG. RIGHT | TOTAL NOTCH LENGTH (IN.) | PERCENT CRACKED |
|---|---|---|---|---|
| 361046LFB1 [illegible] | | | T = .7486 IN. [illegible] | |
| 0. | .165 | .195 | .570 | 18.69 |
| 4000. | .180 | .180 | .590 | 19.65 |
| 8000. | .210 | .205 | .615 | 20.48 |
| 12300. | .265 | .240 | .685 | 22.81 |
| 15000. | .290 | .285 | .775 | 25.81 |
| 18000. | .325 | .325 | .850 | 28.31 |
| 21500. | .380 | .360 | .940 | 31.30 |
| 23000. | .425 | .425 | 1.050 | 34.97 |
| 25700. | .460 | .490 | 1.170 | 38.96 |
| 27100. | .560 | .525 | 1.265 | 42.12 |
| 29000. | .595 | .580 | 1.375 | 45.79 |
| 29600. | .645 | .625 | 1.470 | 48.95 |
| 30400. | .700 | .665 | 1.565 | 52.61 |
| 31100. | .760 | .775 | 1.695 | 56.46 |
| 31600. | .810 | .790 | 1.800 | 59.94 |
| 32100. | .905 | .895 | 1.950 | 64.94 |
| 32300. | .970 | .900 | 2.070 | 68.93 |
| 32300. | 1.400 | 1.400 | 3.000 | 99.90 |
| 361046LFB2 [illegible] | | | T = .7487 IN. [illegible] | |
| 0. | .175 | .165 | .540 | 18.05 |
| 5305. | .195 | .175 | .565 | 18.82 |
| 9785. | .225 | .205 | .625 | 20.95 |
| 12500. | .265 | .235 | .680 | 22.66 |
| 16035. | .295 | .275 | .765 | 25.14 |
| 19045. | .325 | .305 | .825 | 27.48 |
| 21035. | .375 | .360 | .935 | 29.97 |
| 23000. | .395 | .385 | .980 | 32.63 |
| 25700. | .443 | .425 | 1.065 | 35.45 |
| 27700. | .475 | .465 | 1.140 | 37.96 |
| 28090. | .505 | .505 | 1.210 | 40.29 |
| 30200. | .560 | .560 | 1.295 | 42.42 |
| 31200. | .590 | .590 | 1.370 | 45.62 |
| 32100. | .605 | .630 | 1.435 | 47.79 |
| 33100. | .660 | .670 | 1.530 | 51.95 |
| 34100. | .715 | .720 | 1.605 | 54.79 |
| 34600. | .765 | .795 | 1.760 | 58.29 |
| 35200. | .785 | .875 | 1.830 | 60.94 |
| 35600. | .865 | .900 | 1.965 | 65.75 |
| 36000. | .905 | .975 | 2.075 | 68.93 |
| 36300. | .965 | 1.095 | 2.200 | 73.76 |
| 36300. | 1.400 | 1.400 | 3.000 | 99.90 |
| 361046LFB3 [illegible] | | | T = .7500 IN. [illegible] | |
| 0. | .165 | .195 | .560 | 18.65 |
| 10000. | .215 | .225 | .635 | 21.15 |
| 20000. | .265 | .250 | .745 | 24.81 |
| 25000. | .295 | .325 | .825 | 27.47 |
| 30000. | .355 | .365 | .910 | 30.30 |
| 40000. | .395 | .405 | .995 | 33.11 |
| 50115. | .445 | .465 | 1.105 | 36.77 |
| 52000. | .485 | .530 | 1.205 | 41.31 |
| 54300. | .530 | .560 | 1.330 | 44.29 |
| 56000. | .575 | .575 | 1.400 | 46.79 |
| 60000. | .675 | .715 | 1.560 | 52.54 |
| 62700. | .720 | .780 | 1.700 | 56.61 |
| 63000. | .775 | .865 | 1.825 | 60.61 |
| 64000. | .810 | .900 | 1.990 | 64.29 |
| 64700. | .865 | .975 | 2.040 | 68.49 |
| 66000. | .925 | 1.065 | 2.190 | 72.92 |
| 66000. | .975 | 1.113 | 2.295 | 76.43 |
| 66700. | .995 | 1.250 | 2.380 | 79.30 |
| 66900. | 1.400 | 1.400 | 3.000 | 99.90 |
| 361046LFB4 [illegible] | | | T = .7500 IN. [illegible] | |
| 0. | .160 | .165 | .560 | 18.66 |
| 15757. | .275 | .165 | .605 | 20.15 |
| 28793. | .250 | .275 | .635 | 21.00 |
| 36336. | .265 | .285 | .700 | 23.49 |
| [illegible] | .365 | .375 | .800 | 26.64 |
| [illegible] | .395 | .375 | .905 | 30.15 |
| [illegible] | .445 | .425 | 1.005 | 33.40 |
| [illegible] | .485 | .475 | 1.125 | 36.07 |
| [illegible] | .505 | .510 | 1.200 | 40.00 |
| [illegible] | .615 | .700 | 1.405 | 46.80 |
| [illegible] | .665 | .745 | 1.500 | 50.19 |
| [illegible] | .715 | .805 | 1.615 | 53.16 |
| [illegible] | .765 | .845 | 1.700 | 56.63 |
| [illegible] | .815 | .895 | 1.855 | 59.23 |
| [illegible] | .885 | .945 | 1.975 | 63.56 |
| [illegible] | .955 | .975 | 2.095 | 69.17 |
| [illegible] | 1.007 | 1.015 | 2.230 | 74.17 |
| [illegible] | 1.135 | 1.095 | 2.415 | 80.75 |
| [illegible] | 1.165 | 1.115 | 2.565 | 85.46 |
| 77605. | 1.400 | 1.400 | 3.000 | 99.93 |

361046 CF

| CYCLES | FATIGUE CRACK LENGTH (IN.) AVG. LEFT | FATIGUE CRACK LENGTH (IN.) AVG. RIGHT | TOTAL NOTCH LENGTH (IN.) | PERCENT CRACKED |
|---|---|---|---|---|
| 361046CF1 [illegible] | | | T = .7486 IN. [illegible] | |
| 0. | .169 | .169 | .568 | 18.66 |
| 15799. | .164 | .194 | .580 | 18.64 |
| 19000. | .230 | .215 | .635 | 21.00 |
| 25000. | .265 | .265 | .765 | 21.66 |
| 32700. | .300 | .295 | .795 | 25.02 |
| 38000. | .320 | .370 | .895 | 28.66 |
| [illegible] | .350 | .365 | .915 | 30.60 |
| [illegible] | .410 | .435 | 1.060 | 36.75 |
| [illegible] | .465 | .465 | 1.115 | 37.15 |
| [illegible] | .515 | .565 | 1.290 | 42.56 |
| [illegible] | .565 | .565 | 1.365 | 45.65 |
| [illegible] | .625 | .635 | 1.455 | 48.47 |
| [illegible] | .670 | .675 | 1.560 | 51.50 |
| [illegible] | .715 | .715 | 1.625 | 54.12 |
| [illegible] | .765 | .785 | 1.695 | 56.45 |
| [illegible] | .790 | .795 | 1.775 | 58.17 |
| [illegible] | .815 | .870 | 1.865 | 62.50 |
| [illegible] | .860 | .860 | 1.990 | 64.56 |
| [illegible] | .975 | .965 | 2.175 | [illegible] |
| [illegible] | 1.075 | 1.060 | 2.310 | 77.17 |
| [illegible] | 1.180 | 1.125 | 2.500 | 83.20 |
| 70000. | 1.400 | 1.400 | 3.000 | 99.93 |
| 361046CF3 [illegible] | | | T = .7481 IN. [illegible] | |
| 0. | .175 | .165 | .530 | 18.6 |
| [illegible] | .195 | .185 | .560 | 19.13 |
| [illegible] | .235 | .230 | .665 | 22.10 |
| [illegible] | .265 | .265 | .705 | 24.12 |
| [illegible] | .365 | .365 | .830 | 26.61 |
| [illegible] | .395 | .395 | .970 | 29.33 |
| [illegible] | .465 | .465 | 1.130 | [illegible] |
| [illegible] | .505 | .525 | 1.200 | [illegible] |
| [illegible] | .580 | .565 | 1.370 | 40.40 |
| [illegible] | .665 | .665 | 1.480 | 49.40 |
| [illegible] | .690 | .695 | 1.585 | 52.67 |
| [illegible] | .740 | .760 | 1.670 | 57.31 |
| [illegible] | .805 | .815 | 1.795 | 60.01 |
| [illegible] | .870 | .875 | 1.865 | 64.03 |
| [illegible] | .905 | .905 | 2.000 | 66.67 |
| [illegible] | .900 | .965 | 2.140 | 71.42 |
| [illegible] | 1.009 | 1.056 | 2.315 | 77.00 |
| [illegible] | 1.115 | 1.125 | 2.450 | 80.60 |
| [illegible] | 1.175 | 1.160 | 2.590 | 86.01 |
| [illegible] | 1.400 | 1.400 | 3.000 | 100.19 |
| 361046CF2 [illegible] | | | T = .7487 IN. [illegible] | |
| 0. | .162 | .150 | .530 | 18.00 |
| [illegible] | .180 | .175 | .565 | 17.80 |
| [illegible] | .283 | .210 | .650 | 19.90 |
| [illegible] | .257 | .265 | .690 | 21.10 |
| [illegible] | .295 | .337 | [illegible] | [illegible] |
| [illegible] | .365 | .360 | .875 | 29.00 |
| [illegible] | .415 | .405 | 1.000 | 33.30 |
| [illegible] | .475 | .465 | 1.140 | 38.01 |
| [illegible] | .500 | .525 | 1.275 | 41.70 |
| [illegible] | .575 | .565 | 1.360 | 45.25 |
| [illegible] | .625 | .605 | 1.475 | 49.20 |
| [illegible] | .675 | .725 | 1.560 | 52.05 |
| [illegible] | .725 | .775 | 1.680 | 56.00 |
| [illegible] | .800 | .825 | 1.785 | 59.50 |
| [illegible] | .865 | .900 | 1.975 | 64.75 |
| [illegible] | .975 | .900 | 2.125 | 71.25 |
| [illegible] | 1.060 | 1.075 | 2.345 | 78.20 |
| [illegible] | 1.400 | 1.400 | 3.000 | 99.90 |
| 361046CF4 [illegible] | | | T = .7486 IN. [illegible] | |
| 0. | .165 | .195 | .560 | 18.60 |
| [illegible] | .250 | .210 | .605 | 20.11 |
| [illegible] | .285 | .265 | .725 | 24.01 |
| [illegible] | .315 | .305 | .845 | 28.11 |
| [illegible] | .365 | .365 | .925 | 30.74 |
| [illegible] | .445 | .445 | 1.130 | [illegible] |
| [illegible] | .465 | .465 | 1.180 | 39.10 |
| [illegible] | .540 | .515 | 1.290 | [illegible] |
| [illegible] | .585 | .605 | 1.380 | 45.79 |
| [illegible] | .640 | .650 | 1.490 | 49.64 |
| [illegible] | .735 | .750 | 1.580 | 52.44 |
| [illegible] | .765 | .765 | 1.740 | 58.45 |
| [illegible] | .850 | .815 | 1.825 | 60.77 |
| [illegible] | .900 | .910 | 2.130 | 67.64 |
| [illegible] | 1.007 | 1.010 | 2.230 | 74.11 |
| [illegible] | 1.010 | 1.090 | 2.300 | 75.10 |
| [illegible] | 1.400 | 1.400 | 3.000 | 100.00 |

**Notes:**

Cycles - Number of cycles of crack propagation.
Fatigue Crack Length - measured on specimen surface.
Total Notch Length - 0.25-in. long crack starter plus fatigue cracks.
Per Cent Cracked - total notch length expressed as a per cent of gross width.
T - specimen thickness, in.

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# TABLE XXXIX

CRACK PROPAGATION FOR CENTER-CRACKED FATIGUE SPECIMENS
6" x 20" 7075-T652 Hand Forging
Long-Transverse and Short-Transverse Specimens
Constant Load Tests, Stress Ratio = 1/3

| Cycles | Fatigue Crack Length (in.) Avg. Left | Fatigue Crack Length (in.) Avg. Right | Total Notch Length (in.) | Percent Cracked |
|---|---|---|---|---|
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |

Note:
Cycles - Number of cycles of crack propagation.
Fatigue Crack Length - measured on specimen surface.
Total Notch Length - 0.20-in. long crack starter plus fatigue crack.
Per Cent Cracked - total notch length expressed as a per cent of gross width.
T - specimen thickness, in.

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## TABLE XL

[illegible]

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13. ABSTRACT The tensile, compressive, shear, bearing, fracture-toughness, axial-stress fatigue, resistance to stress-corrosion cracking and fatigue-crack propagation rates have been determined for a total of 40 lots of 2014-T652, 2024-T852, 7075-T7352 and 7079-T652 stress-relieved aluminum alloy hand forgings ranging in thickness from 2 through 6 in.

Tables of computed design mechanical properties and typical and minimum stress-strain and compressive tangent-modulus curves were prepared.

Average values of plane-strain stress-intensity factor, $K_{Ic}$, at 5 per cent secant offset were determined.

Log-mean fatigue-life values were calculated.

The forgings of all four alloys have a high resistance to exfoliation and a high resistance to stress-corrosion cracking when stressed in the longitudinal direction relative to the grain flow pattern. In the long and short-transverse test directions, the resistance to SCC varied markedly with respect to alloy and temper, with 7075-T7352 being outstanding, 2024-T852 rating second, and 2014-T652 or 7079-T652 rating third.

The rate of fatigue crack propagation was found to vary with the seven orientations tested and to be substantially faster in a humid atmosphere than in a dry atmosphere. For tests in a salt fog atmosphere, it was demonstrated that a slower rate of loading caused a faster rate of propagation per cycle. At the lower stress intensities the alloys rate in the following decreasing order of resistance to crack propagation: 2014-T652, 2024-T852, 7075-T7352 and 7079-T652.


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| 14. KEY WORDS | LINK A | | LINK B | | LINK C | |
|---|---|---|---|---|---|---|
| | ROLE | WT | ROLE | WT | ROLE | WT |
| 2014 | | | | | | |
| 2024 | | | | | | |
| 7075 | | | | | | |
| 7079 | | | | | | |
| Aluminum | | | | | | |
| Hand Forgings | | | | | | |
| Tensile | | | | | | |
| Compressive | | | | | | |
| Shear | | | | | | |
| Bearing | | | | | | |
| Fracture-Toughness | | | | | | |
| Fatigue | | | | | | |
| Stress-Corrosion | | | | | | |
| Exfoliation | | | | | | |
| Crack Propagation | | | | | | |
| Stress-Relieved | | | | | | |

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